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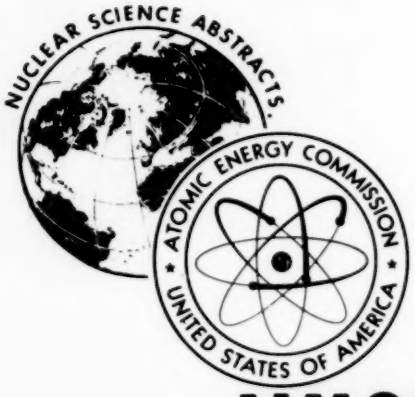

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# NUCLEAR SCIENCE ABSTRACTS

Volume 17 Number 11

Abstracts 17622–19719

June 15, 1963

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Volume 17, Number 11, June 15, 1963

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Volume 17, Number 11 June 15, 1963

# NUCLEAR SCIENCE ABSTRACTS

## GENERAL AND MISCELLANEOUS

**17622** (DASA-1336) TRANSLATIONAL EFFECTS OF AIR BLAST FROM HIGH EXPLOSIVES. Technical Progress Report. I. Gerald Bowen, Paul B. Woodworth, Mary E. Franklin, and Clayton S. White (Lovelace Foundation for Medical Education and Research, Albuquerque, N. Mex.). Nov. 7, 1962. Contract DA-49-146-XZ-055. 78p.

A computational model was used in studies of the biological effects of blast from nuclear explosions. The translational effects of blast waves for objects as small as a 10-mg stone and as large as a 168-lb man were computed from theoretical studies and results were compared to field data for near-ideal blast waves from nuclear explosions. Results indicate that the motion of experimental objects can be satisfactorily predicted for free-field conditions or for window glass in houses. Results were computed for high explosives with free air burst. Parameters computed include velocity, displacement, and acceleration as functions of time for a variety of objects exposed to blast waves with 12 maximum overpressures ranging from 1 to 20 atm. All computations were made for one ton of high explosives burst in free air, but the results may be readily scaled to lower or higher yields and to surface bursts. The missiles are identified by their acceleration coefficients which range from 0.01 to 6.0 $ft^2/lb$. (C.H.)

**17623** (IDO-16827) MATERIALS TESTING REACTOR–ENGINEERING TEST REACTOR TECHNICAL BRANCHES QUARTERLY REPORT, JULY 1–SEPTEMBER 30, 1962. (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). Jan. 15, 1963. Contract AT(10-1)-205. 64p.

The distribution of activity within thick resonance foils was determined experimentally in the ETRC. This is the first phase in the development of a technique for identifying the neutron energy spectra. A method is presented for predicting the excess reactivity in the ETR as a function of power-time. A semi-empirical equation is developed which describes the time dependence of the excess reactivity in terms of certain reactivity parameters determined in the ETRC. Preliminary values were established for the infinitely dilute absorption resonance integrals of natural Hf and Rh. Measurements of the ARMF temperature coefficient of reactivity gave a value of about 27 $\mu k/°C$ at the usual operating temperature of 17 to 18°C. Corresponding coefficients for net sample reactivity vary with sample geometry, sample material, and measurement position. For several arbitrary samples this was on the order of 1 $\mu k/°C$ or less. Sample fuel plate cermet cores containing $UAl_3$ powers blended with Al and $B_4C$ are being clad with high-temperature and corrosion-resistant Al alloys for irradiation, testing, and evaluation purposes. The use of the U–Al intermetallic compound powders combines the potential advantages of the alloy core with those of the cermet core, i.e., high fuel density, good radiation stability, and the possibility of uniformly dispersing burnable poisons in the fuel plates. As part of the mechanical property determinations for fuel elements, tensile tests of various Al alloy and cermet compositions were performed at ambient temperature, 200 and 400°F in the unirradiated condition. It was found, in general, that strength and ductility decrease with an increase in temperature. A new type boron-stainless-steel "control rod" material was evaluated for use in the EOCR. It consists of a boron-stainless-steel core clad with stainless steel and is produced by compacting powders of enriched B and stainless steel as a cermet core and roll bonding between sheets of conventional stainless steel. The cladding remained ductile after irradiation to $1.07 \times 10^{20}$ thermal neutrons per $cm^2$ in the MTR while the core became embrittled. There was no detectable blistering or corrosion of the sample during irradiation. Heat transfer tests on roughened surfaces simulating MTR-ETR fuel channels substantiate predicted improvements in heat transfer film coefficients based on a direct analogy with friction factors. The conceptual design (axial loading and rotating-bending loading) of the ETR in-pile fatigue of structural steels experiment was completed. The study of the decay of the long-lived $Ho^{166}$ isomer revealed four gamma rays whose energies are greater than 1 Mev. These additional transitions were placed in the $Er^{166}$ level scheme. The relative magnitudes of the variances of the expansion coefficient ($\alpha_\lambda$) of a directional correlation-function of the form $W(\theta) = \alpha_0 + \alpha_2 P_2(\cos\theta) + \alpha_4 P_4(\cos\theta)$ were estimated. It is shown that these relative magnitudes are more characteristic of the angular configuration used in the measurement than of the shape of a particular directional-correlation function. The total neutron cross section of $Pa^{233}$ was measured in the thermal region and at 1.0 to 4.0 ev. The total neutron cross section of natural Lu was determined at 0.007 to 100 ev. The irreversible swelling threshold temperature of high purity Be irradiated to a fast (>1 Mev) neutron dosage of $1 \times 10^{21}$ $n/cm^2$ was determined to be ≈725°C. A flow sheet for the chemical separation of gram-size samples of $Pa^{233}$ from irradiated Th was demonstrated on a laboratory scale at full-level Pa concentrations. The scattering of 0.025-, 0.07-, and 0.1-ev neutrons by gaseous methane at −148°C was measured. The inelastic scattering of low energy neutrons by $H_2S$,

$NH_3$, $C_2H_6$, and $C_4H_{10}$ was also determined. The inelastic scattering of 0.020-, 0.0415-, 0.070-, and 0.10-ev neutrons by polycrystalline Be was measured. Analyses of the data for the inelastic scattering of low energy neutrons by Rh at several different temperatures were completed and partial differential cross sections obtained. Further developments in the theory of scattering of neutrons by large molecules were made. A versatile sequence timer was designed for the Spert I destructive tests. The unit activates various equipment at predetermined times during the countdown program. A visual display shows the reactor operator the status of the equipment during this period. A study of the means of analyzing noise spectra was undertaken to determine improved means of measuring reactor noise spectra. Both analysis techniques and equipment design are being investigated. In general, theoretical and experimental results are in agreement. However, some discrepancies do exist and are the subject of further investigation. Improved equipment design is expected to eliminate some of these discrepancies. Evaluation tests of strain gages for high temperature underwater application have emphasized several difficulties. Among these are waterproofing above 300°C, mounting techniques, and thermal expansion effects. The tests will aid in evaluating the data obtained from the Spert I "D" core instrumentation. A library of nuclear codes was assembled at the Bartlesville computing center for use on the IBM 7090 there. A new set of response curves was generated for gamma spectrum analysis, and a FORTRAN code for linear least squares analysis of gamma spectra is being checked out. IREKIN, a versatile reactor kinetics code for the 7090, was written and checked out. (auth)

**17624** (JAERI-5006) ACTIVITIES OF THE HEALTH PHYSICS DIVISION IN JAERI (1962). Report No. 4. (Japan Atomic Energy Research Inst., Tokyo). Mar. 1962. 202p.

Activities at the Institute during the year April 1961 to March 1962 are reported. It is noted that good progress was made especially in construction of facilities such as JRR-3, JPDR, and a light water critical assembly. Special research on body phenomena after a single injection of $Sr^{85}$ is reported along with work on diffusion of radioactive gas released from a stack. Work is reported in sections on radiation control, meteorological and oceanographical survey and observation, and research and development. (J.R.D.)

**17625** (MLM-1144) MOUND LABORATORY PROGRESS REPORT FOR OCTOBER 1962. G. R. Grove, L. V. Jones, J. F. Eichelberger, and E. A. Rembold (Mound Lab., Miamisburg, Ohio). Oct. 31, 1962. Contract AT(33-1)-Gen-53. 30p.

The amount of cross-linking of unfilled diallyl phthalate was determined from the molecular weight, swelling index, and the sol-gel ratio using chloroform. Using infrared spectra techniques, the molecular weight was determined along a strand of plastic extruded from experimental rheometer. A method for preparation of preforms of Dacron-filled diallyl phthalate was developed. $Po^{208}$ and $Po^{209}$, prepared in 1955, are being assayed to determine the decay products. Measurements indicate that the sample now contains about 73% $Pb^{204}$ from decay of $Po^{208}$. The investigation to determine the impurities in Bi slugs containing $Po^{210}$ was completed. Studies show that the ratio of all impurities to Po at the final purification step is approximately one to ten. The separation of $U^{234}$ from $Pu^{238}$ was demonstrated. Initial studies indicate that 94% of the Pu is recovered by solvent extraction with thenoyltrifluoroacetone. Techniques are being developed to encapsulate large quantities of Po in Ta. A 1000 curie source of gadolinium polonide was encapsulated to study the corrosive nature of this compound. Metal capsules are more desirable than quartz capsules because of stability and less oxidation. The scintillation counter to detect trace quantities of $Kr^{85}$ in fission product Xe is being calibrated to find usable counting plateaus. The results indicate that there is a linear relationship between the pressure in the counting chamber and the breakdown voltage. A system to reduce the tritium content in $He^3$ prior to enrichment by thermal diffusion reduces the tritium concentration by a factor of 100. Large Pu alpha plates were calibrated. These plates will be used to calibrate JUNO meters. Several alpha sources were prepared by plating the activity on the end of a hypodermic needle. These sources produced an alpha flux of $3 \times 10^6$ alphas per second per square centimeter at a distance of one centimeter. The technique of covering Po with Au was improved by increasing the adherence of the Au to the Po. More than 90% of the alpha particles are transmitted through the Au layer. Po concentrations as high as 10 microcuries per square centimeter can be covered with gold and remain contamination free. Development studies on this plating technique are continuing. The heats of fusion of six high purity elements were used to calibrate the differential thermal analysis apparatus which will be used to determine the amount of heat in the phase transformations of Pu alloys. The range of operation was calibrated from room temperature to 1000°C. A Pu-Fe alloy, (1% Fe) was prepared by a special homogenizing technique with the sample sealed in a Ta capsule. The viscosity of the liquid alloy was measured at seven different temperatures between 628 and 815°C. The viscosity data are being evaluated. Single crystal x-ray-diffraction studies of $CeCu_4$ show that this compound has an orthorhombic lattice with basic parameters of a = 6.626 ± 0.005 Å; b = 6.644 ± 0.005 Å; c = 8.098 ± 0.005 Å. The density of the compound is 7.35 g/cc. Weissenberg photographs are being developed to determine the space group. Alloy specimens examined by differential thermal analysis in the Cu-rich portion of the Pu-Ce-Co system offer conflicting evidence concerning the existence of a quasi-binary system between $PuCu_2$ and $CeCu_2$. The alloys were prepared for analysis by the electron microprobe x-ray analyzer to obtain positive phase identification. Powder x-ray diffraction photographs of plasma torch produced microspheres of $ZrO_2$ indicate the presence only of the monoclinic form. The high temperature tetragonal form is absent, and the usual structural distortion (cracking, crazing, etc.), which accompanies the tetragonal to monoclinic conversion was not observed. Microspheres of $UO_2$ as large as 125 microns in diameter were produced in the plasma torch without the black color indicative of oxidation. Microspheres of $UO_2$ were reduced to transparent red when heated in $H_2$ at 1000°C for one hour. Lattice constants for 90% Pu–10% $UO_2$ and 80% Pu–20% $UO_2$ were calculated to be 5.4023 ± 0.0005 Å and 5.4008 ± 0.0005 Å, respectively. (auth)

**17626** (NOTS-TP-2986) SOME ASPECTS OF COUPLING BETWEEN EXPLOSIVES AND ROCKS. Charles J. Haas and John S. Rinehart (Colorado School of Mines Research Foundation, Inc., Golden). July 1962. 18p. (NAVWEPS-7949; AD-283296)

The work done in the field of explosive coupling is summarized. Generally, three zones of material behavior are considered when an explosive is detonated in contact with a material. These are the hydrodynamic zone, transition zone, and elastic zone. In seismic studies, coupling refers

to the production of strong seismic signals while decoupling refers to methods of decreasing the amplitudes of seismic signals such as detonating the explosive in an underground cavity larger than the explosive charge. The decoupling factor for such experiments is the ratio of the seismic signal amplitude for a fully tamped shot to the signal amplitude of a shot of the same size in the given cavity. A similar ratio was defined for peak particle velocities. When explosive performance is related to rock breakage, both dynamic shock effects and expansion effects of the explosion gases are considered. United States Bureau of Mines investigators have defined two decoupling factors: the ratio of charge diameter to hole diameter; and vice versa. They have related the amplitude and period of the strain pulse in rock to these decoupling factors. (auth)

**17627** (NYO-2304) REPORT OF PROGRESS [ON CHEMISTRY RESEARCH], MAY 1, 1962–MAY 1, 1963. (Massachusetts Inst. of Tech., Cambridge. Lab. for Nuclear Science). Contract AT(30-1)-905. 70p.

Continued research is reported on nickel cyanide complexes, titanium fluoride complexes, plasma spectroscopy, polarographic anomalies, and reaction order of electrode reactions. Newly initiated investigations are also reported on crystal electrodes, bismuth iodide complexes, ion exchange behavior of liquid ammonia, cyclo-octatetraene complexes of Ag, and sodium naphthalenide. Other work is reported on HCl uptake on ion exchange resins, measurements of isotonic solutions, solvent extraction of metals using aliphatic amines, solvent extraction of salts using perfluorocarboxylic acids, solubility of nitrobenzene in aqueous sulfuric acid, thermodynamic studies of the $Pb(ClO_4)_2$–$HClO_4$–$H_2O$ system, ion activity functions in aqueous LiCl and LiBr, electrolyte behavior in concentrated solutions, relative abundance of $Ca^{43}$ in natural minerals, halogen concentrations in the atmosphere, rain, and sea water, heavy-ion-induced $Cd^{116}$ reactions, decay of $Br^{86}$ and $Br^{87}$, decay schemes of fission-product Sb, Te, and I, and decay scheme of $Cd^{117}$. Studies are reported on energies of photofission fragments, distribution of near-symmetric fragments, isomer yields in fission, prompt neutron emission, and x radiation in fission. Development of a high-transmission bent-crystal spectrometer is reported. Research is also reported in scintillation spectrometry and beta spectroscopy. (J.R.D.)

**17628** (ORNL-3266) A FIFTEEN-YEAR SUMMARY OF PUBLICATIONS INVOLVING THE USES OF ELECTROMAGNETICALLY ENRICHED STABLE ISOTOPES. P. S. Baker (Oak Ridge National Lab., Tenn.). Apr. 4, 1963. Contract W-7405-eng-26. 75p.

A review of some of the accomplishments of the Electromagnetic Separations Department of the Isotope Division of ORNL during its fifteen-year history regarding separation and distribution of electromagnetically enriched isotopes is presented. A bibliography of published literature concerning isotopes and their uses, and categorized according to use, is included. Personal author, corporate author, and isotope indexes are provided. (H.G.G.)

**17629** RESEARCH AND DEVELOPMENT OF A 1-kw PLASMAJET THRUSTER. Robert V. Greco and Willis A. Stoner (Plasmadyne Corp., Santa Anna, Calif.). AIAA (Am. Inst. Aeron. Astronaut.) J., 1: 320-4(Feb. 1963).

Work is reported on the development of a small arc plasmajet thruster suitable for attitude control and orbit adjustment. The effort to date has resulted in a thruster capable of delivering the required thrust (0.01 lb) at a specific impulse in excess of 1100 sec. Kinetic efficiencies in excess of 35% were obtained. This performance was obtained using hydrogen as a propellant. The specific design, along with other designs tested, is reported herein. Some design considerations pertinent to small plasmajet thrusters are presented. (auth)

**17630** CIVIL RESPONSIBILITY AND INSURANCE IN THE NUCLEAR ENERGY FIELD. M. Lagorce (Commissariat à l'Énergie Atomique, Paris). Energie Nucl., 4: 573-81(Dec. 1962). (In French)

After a brief preamble devoted to a review of the actual situation according to French law, the Paris Convention of July 29, 1960, under the sponsorship of the ENEA and OEEC, is reviewed. Nuclear civil responsibility insurance as defined by the various systems reviewed is discussed. (tr-auth)

**17631** MOBILIZATION OF THE NATION'S HEALTH RESOURCES. John M. Whitney (Public Health Service, Kansas City, Mo.). J. Am. Vet. Med. Assoc., 139: 122-6 (July 1961).

The organization of physicians, paramedical personnel, hospital facilities, and drug supplies as a civil defense measure against thermonuclear attack is discussed. (H.H.D.)

**17632** THE NUCLEAR SHIP CONTROVERSY. Roy Herbert. New Scientist, 17: 565-6(Mar. 14, 1963).

Plans for the development of a nuclear-powered merchant ship in Britain are discussed. Both boiling-water and pressurized-water reactors were considered and the designs are described. Objections to the package reactor concept, comments on the brittleness of irradiated steel, and questions on the possibility of salt water getting into the reactor system are answered. Economic issues are also reviewed. (M.C.G.)

**17633** REVIEW AND SUMMARY OF SOME PROJECT GNOME RESULTS. Donald E. Rawson (Univ. of California, Livermore). Trans. Am. Geophys. Union, 44: 129-35(Mar. 1963).

A summary of some results of the Gnome underground nuclear explosion in bedded salt is presented. The report deals primarily with the environment produced by the explosion, touches also on isotope production feasibility, feasibility of power production, seismic measurements, shock studies, and neutron experimentation, and discusses the venting which accompanied the explosion. (auth)

**17634** LEGAL AND INSURANCE MATTERS. Helmut Karr and Werner Boulanger (Bundesminister für Wissenschaftliche Forschung, Bad Godesberg, Ger.). VDI (Ver. Deut. Ing.) Z., 105: 177-80(Feb. 1, 1963). (In German)

Legal and insurance questions related to atomic energy in Western Germany and the German Federal States are discussed. International cooperation is described. (M.C.G.)

**17635** YADERNAYA FOTOGRAFIYA. TRUDY TRET'EGO MEZHDUNARODNOGO SOVESHCHANIYA, MOSKVA, IYUL', 1960. (Nuclear Photography. Proceedings of the Third International Conference, Moscow, July, 1960). K. S. Bogomolov and N. A. Perfilov. Moscow, Publishing House of the Academy of Sciences, 1962. 475p.

Eighty-nine papers are included on the mechanisms of charged particle photography, preparation of nuclear emulsions, properties of photo materials, photographic exposure, devices and methods of automatic recording and analysis of charged particle tracks, and applications of nuclear emulsions. (R.V.J.)

**17636** THE ATOMIC ENERGY DESKBOOK. John F. Hogerton (Little (Arthur D.) Inc., Cambridge, Mass.). New York, Reinhold Publishing Corporation, 1963. 683p. $11.00.

A combination dictionary-encyclopedia of atomic energy principles and applications is presented. It contains over 1,000 entries, ranging from brief definitions of terms to full length articles on major subjects, arranged alphabetically. Cross references are included. Selected reading references are given. (M.C.G.)

**17637** ANNUAL REVIEW OF NUCLEAR SCIENCE. VOLUME 12. Emilio Segre, ed. Palo Alto, California, Annual Reviews, Inc., 1961. 633p.

Reviews on the following subjects are included: inelastic electron scattering; polarization measurements on $\beta$ and $\gamma$ rays; compound statistical features in nuclear reactions; recoilless nuclear resonance absorption; preparation of thin films, sources, and targets; semi-conductor particle detectors; technology of research reactors; atomic displacements in solids by nuclear radiation; electron exchange reactions; isotopic exchange reactions in nonaqueous systems; dispersion relation methods in strong interactions; high-sensitivity mass spectroscopy in nuclear studies; nuclear astrophysics; free radicals in irradiated biological materials and systems. A separate abstract of each review was prepared for NSA. (A.G.W.)

**17638** INELASTIC ELECTRON SCATTERING. W. C. Barber (Stanford Univ., Calif.). Ann. Rev. Nucl. Sci., 12: 1-42(1962).

The exploration of nuclear energy states by means of inelastic electron scattering is reviewed. The cross sections for scattering with nuclear excitation as calculated by different approximate theories are included in a discussion of the theory of inelastic electron scattering. The competing background-producing process of bremsstrahlung during elastic scattering and the relationship between the inelastic electron scattering cross section and the photon absorption cross section are discussed. The apparatus that has been used in inelastic electron scattering and for electrodisintegration experiments is described. The possibility of coincidence experiments in which the scattered electron and a nuclear particle are detected simultaneously is considered. The results of the experiments and their combination with theories to derive properties of nuclear excited states are discussed. (109 references) (A.G.W.)

**17639** THE POLARIZATION MEASUREMENTS ON BETA AND GAMMA RAYS. Lorne A. Page (Univ. of Pittsburgh). Ann. Rev. Nucl. Sci., 12: 43-78(1962).

Since the discovery of parity violation in $\beta$ decay in 1957, the state of the art of measuring polarization of electrons, positrons, and photons has improved. A brief history of work on polarization of these particles between 1906 and 1957 is given, and general aspects of the problem are considered. The various methods used to measure the polarization of $\gamma$ rays, $e^+$, and $e^-$ since 1957 are summarized. (112 references) (A.G.W.)

**17640** COMPOUND STATISTICAL FEATURES IN NUCLEAR REACTIONS. David Bodansky (Univ. of Washington, Seattle). Ann. Rev. Nucl. Sci., 12: 79-122(1962).

Theoretical aspects of the statistical model of compound nuclear processes are outlined. The relation of the statistical model to observable aspects of reactions (spectra, yields and excitation functions, angular distributions, and level counting) is considered. Experimental information obtained during the past several years is reviewed, and its consistency with the statistical model is discussed. It is concluded that the statistical model provides a good approximate description of the experimental observations for most events initiated by projectiles of intermediate energy. (120 references) (A.G.W.)

**17641** RECOILLESS NUCLEAR RESONANCE ABSORPTION. R. L. Moessbauer (California Inst. of Tech., Pasadena). Ann. Rev. Nucl. Sci., 12: 123-52(1962).

The phenomenon of recoilless nuclear resonance absorption was discovered in 1958. The theory of recoilless transitions and the experimental technique used are described. The basic feature of the method of observation of nuclear resonance absorption based on this type of transition is the attainment of a complete energy resonance between identical types of emitting and absorbing nuclei. Applications of the method include studies of hyperfine splitting and polarization of $\gamma$ lines, shifts of the emission and absorption spectra, and relativistic effects. Recoilless scattering and coherence problems and frequency distribution of the transmitted radiation and its time dependence are discussed briefly. (115 references) (A.G.W.)

**17642** PREPARATION OF THIN FILMS, SOURCES, AND TARGETS. L. Yaffe (McGill Univ., Montreal). Ann. Rev. Nucl. Sci., 12: 153-88(1962).

Methods of preparation and properties of thin films, sources, and targets are reviewed. Most of the thin films currently being used are plastic, but Al, C, B, aluminum oxide, and silicon monoxide films are discussed briefly. Methods of estimating film thickness and rendering the film conducting are summarized. Techniques described for preparation of thin sources and targets include evaporation of a solution or suspension, electrospraying, vacuum evaporation, electrodeposition, and ion acceleration. Data on the following are summarized in tables: preparation of radioactive sources by vacuum deposition, elements that have been deposited electrolytically to make radioactive sources and targets, and elements from which targets have been made by distillation in vacuo. (284 references) (A.G.W.)

**17643** SEMICONDUCTOR PARTICLE DETECTORS. G. L. Miller (Brookhaven National Lab., Upton, N. Y.), W. M. Gibson, and P. F. Donovan. Ann. Rev. Nucl. Sci., 12: 189-220(1962).

The operation, properties, and fabrication of semiconductor detectors are reviewed. Materials other than Ge and Si are mentioned only briefly. The electronics involved in use of semiconductors as particle detectors is discussed. Application and possible applications to the following are summarized: nuclear reaction charged-particle spectroscopy, particle identification, mosaics and special structures, $\alpha$-particle spectroscopy, fission studies, neutron spectroscopy, $\beta$ spectroscopy, $\gamma$ spectroscopy, detection of minimum-ionizing particles, low-temperature physics, space vehicles, industry, and medicine. (231 references) (A.G.W.)

**17644** TECHNOLOGY OF RESEARCH REACTORS. Thomas E. Cole and Alvin M. Weinberg (Oak Ridge National Lab., Tenn.). Ann. Rev. Nucl. Sci., 12: 221-42(1962).

Engineering developments in the field of high-power ($10^{14}$ and $10^{15}$ neutrons/cm$^2$ sec) research reactors are reviewed with emphasis on fuel element technology and the principle of the flux trap. Calculational methods used in designing reactors are discussed. Several examples of two types of advanced research reactor are described: plate-fuel-element tank reactors and pulsed reactors. Present policies with regard to site selection and containment of research reactors are reviewed briefly. The more important nuclear accidents involving research reactors are summarized. (52 references) (A.G.W.)

**17645** ATOMIC DISPLACEMENTS IN SOLIDS BY NUCLEAR RADIATION. Allen N. Goland (Brookhaven

National Lab., Upton, N. Y.). Ann. Rev. Nucl. Sci., 12: 243-84(1962). (BNL-6093; TID-16299; MRL-120)

The important interactions between radiation and matter are summarized. Theories for defect production are compared. The importance of interatomic potentials in calculations of radiation damage and defect stability is discussed. Defect configurations predicted by theory and the proposed mechanisms for their production are described. Techniques developed since 1956 for direct and indirect observation of defects are reviewed. Experimental results most readily interpreted in terms of theoretical predictions are discussed. (151 references) (A.G.W.)

**17646** ELECTRON EXCHANGE REACTIONS. N. Sutin (Brookhaven National Lab., Upton, N. Y.). Ann. Rev. Nucl. Sci., 12: 285-328(1962). (BNL-6061)

Two types of oxidation-reduction reactions are considered: (1) the type $Fe^{2+} + Fe^{3+} \rightleftharpoons Fe^{3+} + Fe^{2+}$ in which the net result is the transfer of one or more electrons between two oxidation states of a single element, and (2) the type $U^{3+} + UO_2^+ \rightleftharpoons UO^{2+} + UO^{2+}$ in which the net result is the transfer of one or more electrons between two different chemical forms of the same element. Experimental methods are summarized, and data on transition elements, lanthanide elements, actinide elements, and some nontransition elements are reviewed. Factors believed to influence the rate of reaction and the problem of whether two-electron exchange reactions proceed by simultaneous transfer of two electrons or in one-electron steps are considered. Theories of electron exchange reactions are discussed and compared with experimental results. (161 references) (A.G.W.)

**17647** ISOTOPIC EXCHANGE REACTIONS IN NONAQUEOUS SYSTEMS. Rolfe H. Herber (Rutgers Univ., New Brunswick, N. J.). Ann. Rev. Nucl. Sci., 12: 329-58 (1962).

Work on isotopic exchange studies that has appeared in the literature since March 1957 is reviewed. Reactions in the gas phase, reactions in ionizing and nonionizing solvents, exchange in heterogeneous systems, and reactions under nonequilibrium conditions are considered. (251 references) (A.G.W.)

**17648** DISPERSION RELATION METHODS IN STRONG INTERACTIONS. Daniele Amati and Sergio Fubini (CERN, Geneva and Università, Turin). Ann. Rev. Nucl. Sci., 12: 359-434(1962).

The physical ideas at the basis of the dispersion method are reviewed. General properties of the scattering matrix, anomalous thresholds and the Landau-Cutkosky rules, the Mandelstam representation, and charge and spin are considered. The applications of dispersion theory to physical processes are discussed. (155 references) (A.G.W.)

**17649** HIGH-SENSITIVITY MASS SPECTROSCOPY IN NUCLEAR STUDIES. Heinrich Hintenberger (Max Planck-Institut für Chemie, Mainz). Ann. Rev. Nucl. Sci., 12: 435-506(1962).

Methods of ion production, ion detection, and separation of ion beams into particles of different masses are summarized. Proved machines and methods and their efficiency are considered. Applications of mass spectroscopic methods to identification of end products of radioactive decay products, mass spectra of radioactive substances, half-life determinations, cross-section determinations, and branching ratio determinations are reviewed. Information that can be obtained from studies of isotopic composition of meteorites is discussed. (385 references) (A.G.W.)

**17650** NUCLEAR ASTROPHYSICS. Geoffrey Burbidge (Univ. of California, San Diego). Ann. Rev. Nucl. Sci., 12: 507-76(1962).

The eight types of nuclear processes involved in synthesis of all the elements in stars and the most recent developments relating to each of the processes are summarized. The evidence for element synthesis in stars obtained from astronomical observations is described. The role of neutrino emission in stellar evolution, the properties of matter at high densities, and age determinations from radioactive nuclei in the solar system are considered. Developments related to the role of nuclear energy generation and release in normal supernovae and the deductions that can be made from the observations concerning the existence of fluxes of high-energy particles are reviewed. (265 references) (A.G.W.)

**17651** FREE RADICALS IN IRRADIATED BIOLOGICAL MATERIALS AND SYSTEMS. Douglas E. Smith (Argonne National Lab., Ill.). Ann. Rev. Nucl. Sci., 12: 577-602(1962).

Published work on the use of electron spin resonance (ESR) in detecting free radicals in irradiated biological materials is reviewed. The basis of the ESR method and the type of information it provides are described briefly. Experimental work on biochemicals irradiated in the solid state and on irradiated tissues and cell components is discussed. The correlation between the presence or absence of radicals and the development of biological damage is considered. (161 references) (A.G.W.)

# BIOLOGY AND MEDICINE

## General and Miscellaneous

*Refer also to abstracts 18495, 18496, 18499, 18500, and 18503.*

**17652** (UCRL-10634) BIO-ORGANIC CHEMISTRY QUARTERLY REPORT, SEPTEMBER–NOVEMBER 1962. (California. Univ., Berkeley. Lawrence Radiation Lab.). Jan. 18, 1963. Contract W-7405-eng-48. 123p.

Results are reported from studies on the synthesis of amino acids by chlorella in which $C^{14}$ in the form of $C^{14}O_2$ and $HC^{14}O_3^-$ and $N^{15}$ in the form of $N^{15}H_4^+$ were used as dual tracers in a steady-state photosynthesis apparatus. A colorimetric method was used for the determination of total amino acids and the amino acids were converted to nitrogen gas for the determination of $N^{15}$ content with a mass spectrometer. The relative rates of labeling were compared in terms of percentage labeling of the total pools. The initial points of entry of amino nitrogen into the biosynthetic pathways are discussed. A subunit was isolated from spinach chloroplast lamellae that appeared homogeneous in the ultracentrifuge. This subunit appeared to satisfy the requirements of the photosynthetic unit in terms of chlorophyll content and molecular weight and also to approximate the dimensions of the quantasome. The physical characteristics of this particle are described and its relation to the photosynthetic unit is discussed. Light scattered by spinach quantasomes at wavelengths where absorption is negligible was observed to be strongly polarized. Preliminary measurements of dipolarization ratio for several preparations of quantasomes suggested that the apparent anisotropy of the polarizability ellipsoid varies from about 0.14 for monomer quantasomes to about 0.24 for medium-sized aggregates. The significance of these values is discussed qualitatively in terms of intrinsic anisotropy and form anisotropy of the polarizability. Measurements suggested that at 750 mμ quantasomes have a refractive index of 1.5. Fluorescence from each of the quantasome preparations studied was observed to be strongly depolarized. It was concluded that the majority of pigment molecules have a large variety of orientations within the particle. The use of the nuclear activation reaction $O^{18}(\alpha,n)Ne^{21}$ in the use of $O^{18}$ as a tracer in biological systems was investigated. It was concluded that the method offers some promise of success. Design features are described of a high-sensitivity rapid-response spectrophotometer for use in studies of primary energy conversion processes in photosynthesis. The performance of a microspectrophotometer in studies on the spectra of crystals of organic solids is discussed. Results are reported from studies on the radiolysis of crystalline choline chloride. Investigations were continued on the synthesis of organic compounds under possible primitive earth conditions by the use of electric discharges. Methane, ethane, and concentrated ammonium hydroxide were used in the reaction mixtures and $C^{14}$-hydrocarbons, mainly methane-$C^{14}$, were used as tracers. The products formed included amino acids, hydroxy acids, isoleucine, asparagine, possibly glycinamide, a yellowish oil, a highly-insoluble polymer, several ultraviolet-absorbing compounds, and products that gave brown and green-colored derivatives with ninhydrin that were presumed to be amines, amino amides, and amino nitriles. Radioautograms were prepared of two-dimensional chromatograms of the products. Organic compounds formed in the irradiation by high-energy electrons of mixtures of methane, ammonia and water in both the gas and solid phase were similar to those obtained by electric discharges. Results are included from investigations on the chemical composition of the Murray meteorite. (C.H.)

**17653** (USNRDL-TR-603) MATURATION OF LIVER FUNCTION IN THE CHICK EMBRYO. R. W. Brauer, L. M. Julian, and J. S. Krebs (Naval Radiological Defense Lab., San Francisco). Dec. 14, 1962. 49p.

A detailed study of the process of maturation of liver function in the developing chick embryo reveals at least three different time courses describing various aspects of the phenomena. Conjugation and concentrating or storing ability are well developed by the 9th day of incubation; maximal BSP transfer capacity matures by the 14th day; and clearance of BSP and ability to secrete selectively submaximal doses of BSP may not have reached maturity by the 18th day of incubation. Finally, while conjugating and concentrating abilities of the liver for BSP are clearly present on the 8th and 9th days, the ability to secrete BSP into bile does not appear until the 11th day of incubation. Analysis of the data suggests that two broad aspects of functional maturation must be considered. These include functional maturation at the level of individual cells, including organelle development, membrane differentiation, and appearance of specific enzymes and functional maturation at the organ level, involving both juxtaposition of cell populations and tissue elements, and uniformity of attainment of functional maturity. (auth)

**17654** RADIATION CHIMERAS. P. C. Koller, A. J. S. Davies, and Sheila M. A. Doak (Royal Cancer Hospital, London). Advan. Cancer Res., 6: 181-289(1961).

**17655** HYPOPARATHYROIDISM FOLLOWING RADIOACTIVE IODINE THERAPY FOR INTRACTABLE ANGINA PECTORIS. James D. Townsend. Ann. Internal Med., 55: 662-3(Oct. 1961).

A case history of a patient with recent myocardial infarction who was treated with $I^{131}$ and subsequently developed hypoparathyroidism is described. The initial treatment consisted of 3 weekly injections of 10 mC $I^{131}$. This resulted in hypocalcemia and other signs of parathyroid insufficiency but not the desired hypothyroidism. Therefore, an additional course of 3 weekly 10-mC treatments of $I^{131}$ was given. This resulted in relief of anginal symptoms but parathyroidism became more severe, requiring treatment with vitamin D and Ca lactate to maintain normal blood levels of Ca and phosphate. Hypoparathyroidism appears to be a rare sequel to $I^{131}$ since only 6 previous cases have been reported. (H.H.D.)

**17656** A BIOSYNTHESIS CHAMBER FOR PRODUCING PLANTS LABELED WITH CARBON-14. J. H. Smith, F. E. Allison, and J. F. Mullins (U. S. Department of Agriculture, Beltsville, Md.). Atompraxis, 9: 73-5(Mar. 1963). (In English)

A relatively low-cost biosynthesis chamber for growing plants labeled with $C^{14}$, which has performed satisfactorily for more than two years, is described. The design incorporates a system for automatically controlling the $CO_2$ content of the chamber. The temperature, day length, illumination, nutrient culture, and humidity are also controlled. Automation of the facility markedly reduced the labor cost associated with an operation of this type. (auth)

**17657** AN APPARENT SELENIFEROUS LEAF WAX FROM STANLEYA BIPINNATA. R. J. McColloch, J. W. Hamilton, and S. K. Brown (Univ. of Wyoming, Laramie). Biochem. Biophys. Res. Commun., 11: 7-13(Apr. 2, 1963).

Selenium$^{75}$ was used as a tracer to demonstrate that Se is intimately associated with leaf wax from Stanleya bipinnata, a member of the mustard family. Results are reported from studies that suggest, but do not conclusively prove, that Se is a chemical part of the wax molecules. This would indicate a biochemical adaptation of Stanleya and would suggest that the metabolism of Se in these plants may differ significantly from that of sulfur. (C.H.)

**17658** EFFECTS OF INTRODUCTION OF A RADIOACTIVE TANTALUM ($Ta^{182}$) WIRE IN THE INTERNAL MAMMARY ARTERY: EXPERIMENTAL STUDIES. G. Peracchia, P. Robbie, and P. Vecchi (Università, Parma, Italy). Boll. Soc. Ital. Biol. Sper., 37: 832-4(Sept. 15, 1961).

A possible technique for radiotherapy of breast cancer was explored in dogs. It was thought that by introduction of a radioactive wire into mammary blood vessels a relatively high radiation dose could be delivered to cancer cells metastasizing to the regional lymph nodes. The $Ta^{182}$ wire had a diameter of 0.2 mm and an activity of 1 mc/cm; a 10- to 13-cm length was inserted. It was estimated that 100% of the radiation dose would extend to 0.5 cm, 48% to 1 cm, 21% to 2 cm, 12% to 3 cm, and 5% to 4 cm. Experiments were conducted in 10 dogs in which the doses used were 6000 to 16000 r, calculated for a distance of 0.5 cm from the wire. The dogs were autopsied 2 months after removal of the wire, which had been inserted during thoracotomy in the internal mammary artery. Adjacent lung tissue and sternal musculature showed no gross abnormalities. Histologic examination of the artery showed discontinuities in the intimal layer, fragmentation of the internal elastic membrane, and cellular infiltration of the medical layer. None of the changes was noted in the corresponding vein. Lung tissue showed some interstitial and peribronchiolar infiltration of inflammatory cells and incipient fibrosis. It is suggested that the method might be useful in human breast cancer because of the lymph node distribution around the vessels in man. (P.C.H.)

**17659** A POSSIBLE TWO-STAGE MECHANISM IN RHABDOMYOSARCOMA INDUCTION IN RATS. N. Haran-Ghera, N. Trainin, L. Fiore-Donati, and I. Berenblum (Weizmann Inst. of Science, Rehovoth, Israel). Brit. J. Cancer, 16: 653-64(Dec. 1962).

The possibility is suggested that a two-stage mechanism of carcinogenesis functions in rats with respect to the induction of rhabdomyosarcoma. Results are reported from a series of studies that indicate that x radiation acts as an initiating factor and wound healing of the liver following laparotomy acts as a promoting factor. (C.H.)

**17660** ATTEMPTED TUMOUR THERAPY COMPLICATED BY A VIROID ASSOCIATE OF THE TUMOUR. K. Lapis and A. J. S. Davies (Royal Cancer Hospital, London). Brit. J. Cancer, 16: 763-9(Dec. 1962).

An account is presented of unsuccessful attempts to cure the NK/Ly ascites tumor in mice by doses of Degranol or irradiation which, had they not been followed by syngeneic marrow therapy, would have proved lethal as a consequence of hematopoietic failure. Reasons for the lack of success are discussed and it is concluded that even the high doses of anti-tumor agents given were insufficient to eradicate the tumor and that the treated animals died before the controls because a virus or virus-like entity associated with the tumor seriously impeded hematopoietic recovery. (auth)

**17661** STUDIES ON PLASMA LACTIC DEHYDROGENASE IN MICE WITH MYELOID LEUKEMIA. I. RELATION OF ENZYME LEVEL TO COURSE OF DISEASE. K. Nishio, K. B. Jacobson, V. K. Jenkins, and A. C. Upton (Oak Ridge National Lab., Tenn.). Cancer Res., 23: 340-3(Mar. 1963).

The plasma lactic dehydrogenase (LDH) activity was increased in RF mice with primary and transplanted radiation-induced myeloid leukemia. The degree of elevation in mice with transplanted leukemia varied irregularly with the time after transplantation and with the transplant generation, the mean of all values being about 14 times normal. The extent of LDH increase in any transplant generation was correlated with the severity of leukemic infiltration of the liver and other organs. This correlation indicates that LDH mirrors the severity of the leukemic process. Whole-body x-radiation in the absence of transplanted leukemia, also caused a transient elevation of plasma LDH. (auth)

**17662** STUDIES ON PLASMA LACTIC DEHYDROGENASE IN MICE WITH MYELOID LEUKEMIA. II. ON THE SITE OF PRODUCTION OF THE ENZYME. K. B. Jacobson and K. Nishio (Oak Ridge National Lab., Tenn.). Cancer Res., 23: 344-8(Mar. 1963).

The site of production of the lactic dehydrogenase (LDH) that appears in the plasma of leukemic mice has been studied by technics employing various analogs of nicotinamide adenine dinucleotide. The LDH of several normal organs was characterized and shown to differ from the enzyme which appears in the leukemic plasma. The most likely source of the enzyme, based on these studies, is the tumor cell itself. (auth)

**17663** THE SURGICAL TREATMENT OF X-RAY ULCERS. L. Held (Chirurgische Universitatsklinik, Erlangen, Ger.). Chirurg, 32: 363-7(Aug. 1961).

Plastic surgery techniques used to treat 24 patients with skin ulcers as a result of excessive radiotherapy doses are described and extensively illustrated. The principal dangers of such unhealed ulcers are infection and malignant transformation, so that adequate surgical excision and repair are essential to avoid late complications. Ulcers may arise as late as 1½ yr after the appearance of radiodermatitis and may be attributed mainly to the radioinduced thrombosis and destruction of blood vessels in skin. Failure of the blood supply to outer layers of skin promotes necrosis and prevents regeneration of cellular elements. Radical surgical excision of the necrotic, fibrotic regions and plastic surgical repair are recommended as the only sure methods of lasting cure of the ulcers and prevention of their sequelae. The fluorescence method is best for delineating dead from viable tissue before surgery. Closure of the defect after surgery, with flaps of skin fat, was found to be the best method to ensure rapid repair of the grafts. In 23 of 24 patients treated in this way, satisfactory healing was obtained in an average of 4.2 months. In 2 of the 24 cases, carcinomas developed 16 and 21 yr postoperatively, respectively. It was concluded that essentially all x-ray ulcers are amenable to successful surgical treatment. (TCO)

**17664** QUANTITATIVE RADIOCARDIOGRAPHY. I. THEORETICAL CONSIDERATIONS. L. Donato, C. Giuntini, M. L. Lewis, J. Durand, D. R. Rochester, R. M. Harvey, and A. Cournand (Columbia Univ., New York). Circulation, 26: 174-82(Aug. 1962).

The theoretical background and limits of radiocardiography for the measurement of cardiac output, and of right ventricular and pulmonary blood volumes, are discussed. Injection of a known amount of radioiodinated ($I^{131}$) human

serum albumin (RIHSA) into the right atrium, and concomitant recording of a double-peaked time activity curve by means of a shielded scintillation detector placed over the precordium, allows measurement of cardiac output. The geometric arrangements that best approach ideal conditions are described. It is shown that the physiologic significance of the value for output as measured from the radiocardiograms varies with the indicator-flow ratio in 2 sides of the heart. The necessary conditions for measurement of right ventricular volumes from the radiocardiograms are presented, and the theoretical limits of the technic are evaluated. The problem of the measurement of pulmonary blood volume (PBV) from RIHSA radiocardiograms is discussed. While it is not possible to make a direct measurement of mean PBV from RIHSA radiocardiograms, the limits within which the volume lies are indicated. (P.C.H.)

**17665** QUANTITATIVE RADIOCARDIOGRAPHY. II. TECHNIC AND ANALYSIS OF CURVES. L. Donato, D. F. Rochester, M. L. Lewis, J. Durand, J. O. Parker, and R. M. Harvey (Columbia Univ., New York). Circulation, 26: 183-8(Aug. 1962).

The instrumentation and procedure employed to secure radiocardiograms and the technic of analysis of the resulting curves are described. Time activity curves are recorded by means of a scintillation counter, with a NaI crystal $1\frac{1}{2}$ in. in dia. located in a lead collimator. Pulses from the photomultiplier tube are amplified and fed into a counting ratemeter and into a scaling circuit. The output of the ratemeter is fed into a multichannel electronic recorder, with monitoring oscilloscope. A solution of radioiodinated ($I^{131}$) human serum albumin (RIHSA) or $Kr^{85}$ is introduced into the right atrium by cardiac catheterization, and the resulting scintillation readings taken over the precordium are recorded along with the electrocardiogram. The curves are analyzed by reading at every 0.1 sec the height of the deflection in millimeters above the background. The latter is obtained by averaging over several seconds the ratemeter trace immediately before the curve. The net deflections are plotted on semilogarithmic paper against time on the linear abscissa. The downslope of the second peak is fitted with a single exponential. Various parameters needed for the calculations of right ventricular volume and pulmonary blood volume are discussed. (P.C.H.)

**17666** QUANTITATIVE RADIOCARDIOGRAPHY. III. RESULTS AND VALIDATION OF THEORY AND METHOD. M. L. Lewis, C. Giuntini, L. Donato, R. M. Harvey, and A. Cournand (Columbia Univ., New York). Circulation, 26: 189-99(Aug. 1962).

Previously described theoretical considerations and technics employing $Kr^{85}$ and radioiodinated ($I^{131}$) human serum albumin (RIHSA) were applied to the hemodynamic study of 37 subjects. Cardiac output, right ventricular, and pulmonary blood volume were determined in normals, emphysematous subjects, and patients with various types of heart disease. Values of blood flow obtained by means of the technic were compared with those measured simultaneously by the direct Fick method. A linear correlation was demonstrated between $Q_{RIHSA}$ and $Q_{Fick}$, with a regression coefficient of $1.0395 \pm 0.0566$, when correction was made for the contribution of activity in paracardiac tissues. The principle of measurement of right ventricular rate of emptying from the fractional decay rate of precordial counting during the passage of indicator through the right heart was validated. The significance of variability observed in emphysematous patients is discussed. The right ventricular end-diastolic and residual volumes averaged $221 \pm 50$ ml and $128 \pm 34$ ml, respectively, in 18 normal subjects. The calculated pulmonary blood volume in 18 normal subjects averaged $313 \pm 58$ ml/m$^2$. (P.C.H.)

**17667** SYMPOSIUM: TOTAL-BODY IRRADIATION; INTRODUCTION. David Harris (Naval Hospital, Bethesda, Md.). Clin. Proc. Children's Hosp., 17: 145-6(June 1961).

The history of the therapeutic use of ionizing radiations is briefly considered. (H.H.D.)

**17668** AN ADMINISTRATIVE CHALLENGE: NUCLEAR MEDICINE. John S. Hellman. Hosp. Progr., 42: 52-8 (Feb. 1961).

The development of nuclear medicine facilities in hospitals in the United States is discussed, particularly in relation to the problems presented to hospital administration for understanding, organizing, and planning such facilities. The increase in the number of hospital radioisotope departments from 1952 to 1958 was 300%, a growth unparalleled by any other major hospital service. Today, 20% of the hospitals in the U. S. maintain radioisotope departments. Reasons for the relative lag among smaller hospitals are discussed. Responsibilities of administrations, in seeing that A.E.C. licensing requirements for the use of radioisotopes in general hospitals are maintained, are outlined. Organization of a hospital isotopes committee and appointment of a safety officer is commented on. After an outline of the various radioisotope techniques most useful to the general hospital, the cost of the necessary equipment and other laboratory facilities is estimated. Other problems discussed in relation to responsibilities of hospital administrators include laundry decontamination, shielding, training of nursing personnel, information programs for personnel, legalities arising over radiation exposure claims, and the corresponding need for the keeping of records, autopsies, insurance, waste disposal, public fears and misconceptions, sanitation, and film badge monitoring. (H.H.D.)

**17669** DENTAL RADIOLOGICAL RESEARCH. Harry D. Spangenberg (Ohio State Univ., Columbus). J. Am. Dental Assoc., 64: 641-5(May 1962).

Dental radiological research carried on between January 1960 and November 1961 is reviewed. Topics considered include physics, new technics, roentgenographic interpretation, radiation hygiene, tissue changes induced by radiation, and chemical protection against radiation damage. (H.H.D.)

**17670** NORMAL FLORA OF THE NOSE, THROAT, AND LOWER INTESTINE OF DOGS. W. E. Clapper and G. H. Meade (Lovelace Foundation for Medical Education and Research, Albuquerque, N. Mex.). J. Bacteriol., 85: 643-8(Mar. 1963).

An attempt was made to isolate and identify the complete normal flora of the rectum, nose, and throat of beagles. From the rectal specimens, 20 species of bacteria and 10 species of fungi were isolated and identified. The organisms were similar to those found in the human intestine. Escherichia coli, Streptococcus mitis, enterococci, S. lactis, Bacillus species, and coliforms other than E. coli were most frequently encountered. (auth)

**17671** A METHOD FOR INTRACELLULAR AUTORADIOGRAPHY IN THE ELECTRON MICROSCOPE. M. H. Silk, A. O. Hawtrey, I. M. Spence, and J. H. S. Gear (Poliomyelitis Research Foundation, Johannesburg). J. Biophys. Biochem. Cytol., 10: 577-87(Aug. 1961).

A technique is described for high-resolution intracellular autoradiography in the electron microscope. Cultured cells were incubated for 72 hr in a medium containing 0.4

$\mu$C/ml thymidine-$H^3$. After labeling, the cells were fixed with osmium tetroxide and embedded in methacrylate. Ultrathin sections of the labeled tissue were taken up on grids, and a 150 to 450 Å layer of silver metal was then evaporated onto the tissue. The coated grids were exposed to bromine vapor for 1.5 to 2 min under red light, allowed to dry for 1 min and then covered with a thin film of 1% aqueous gelatin. For autoradiographic exposure, the grids were stored 50 days. After development and removal of the gelatin, the autoradiograms were dried and examined in the electron microscope. Ultrastructural detail was fairly well defined and the cytoplasm of each labeled cell was covered with an electron opaque deposit of silver, suggesting that a polynucleotide containing thymidine may be synthesized in the cytoplasm. (H.H.D.)

**17672** TOWARDS REDUCED RADIATION EXPOSURE IN PELVIMETRY. E. A. Williams and R. A. Williams (Royal Gwent Hospital, Newport, Eng.). J. Obstet. Gynaecol. Brit. Commonwealth, 68: 1022(Dec. 1961).

Use of a wooden chair for examination of pregnant women by roentgenography is described. The lateral roentgenograms thus obtained permit reduced x-ray doses to the fetus and maternal gonads. (H.H.D.)

**17673** ROLE OF ALVEOLECTOMY IN PREVENTION OF RADIONECROSIS OF THE JAWS AND ORAL SOFT TISSUES. C. Jules Rominger, John Looby, and John Duncan (Misericordia Hospital, Philadelphia). J. Oral Surg. Anesthesia Hosp. Dental Serv., 20: 72-7(Jan. 1962).

In the radiotherapy of oral cancer, radionecrosis of the jaws and oral soft tissues continues to be a severe complication despite advances in radiation therapy devices resulting in less energy absorption in bone. The major factor in the development of osteoradionecrosis is the condition of the teeth prior to, during, and subsequent to radiation therapy for carcinoma of the oral cavity. It is suggested that any diseased teeth requiring extraction, and all teeth in the planned path of irradiation, should be extracted prior to radiation therapy if their removal would not allow a contiguous tumor to invade the mandible through their sockets. It is also proposed that alveolectomy should accompany the extractions to eliminate the sharp interdental septa that later pierce the irradiated gingivae and open a pathway for infection. Soft tissue necrosis also can result from irritation by these sharp septa. The role of alveolectomy is discussed and illustrated by several case reports showing the complications that can ensue if alveolectomy is not carried out. (P.C.H.)

**17674** PEDIATRICS AND NUCLEAR MEDICINE. Harry Medovy (Univ. of Manitoba, Winnipeg, Can.). J. Pediat., 59: 161-3(July 1961).

Proceedings of a conference, attended by 75 pediatricians from the United States and Canada, at the Brookhaven National Laboratory in March, 1961, are reported. Some conclusions arrived at, and of general interest to pediatricians for reducing radiation exposure in young children, are discussed. For example, it is recommended that image intensifiers be made available for fluoroscopy in all children's hospitals as soon as possible. This is a matter of necessity in view of the fact that a one-minute exposure of a child to fluoroscopy is equal in radiation dosage to 300 chest films. Radioactive isotopes should not be used in childhood age groups until all other diagnostic or investigative avenues have been exhausted. Even then, there should be a positive indication for their use. Training of pediatricians in the fundamentals of nuclear medicine is recommended. Various radiotherapy devices and techniques available at the Brookhaven laboratory are briefly discussed. (H.H.D.)

**17675** RADIUM THERAPY APPLIANCE. David P. Dobson, John B. Sowter, William P. Webster, and Herbert F. Johnson (Univ. of North Carolina, Chapel Hill). J. Prosthetic Dentistry, 11: 1166-9(Nov.-Dec. 1961).

A device for holding Ra capsules in the mouth is described. The device enabled the local irradiation with 10500 r of a maxilliary carcinoma without exposing the eyes to excessive doses. (H.H.D.)

**17676** MICRORADIOAUTOGRAPHY IN INTERNAL IRRADIATION OF THE PROSTATE. A. M. Behnam, C. V. Hodges, and Joan Thye (Univ. of Oregon, Portland). J. Urol., 88: 805-11(Dec. 1962).

In preliminary attempts to find a technique for internal irradiation of the prostate, studies using regional perfusion of the dog's prostate with $P^{32}$ compounds showed that the prostate received higher concentrations of the isotope than other viscera. Whether the isotope was deposited intraepithelially or was present only in the extracellular fluid was investigated by microradioautography. Two compounds containing $P^{32}$, sodium phosphate and diethylstilbestrol diphosphate, were used. Four methods for introducing $P^{32}$ into the epithelial cells of the dog's prostate are described: intravenous injection, intra-arterial infusion, regional perfusion, and retrograde injection via the urethra. Intraepithelial localization of both $P^{32}$-labeled compounds was demonstrable in microradioautographs of prostate, especially when urethral injections were made. The radioactivity of prostate was ~400 times higher by this route compared with the other 3 when measurements were made 24 hr postinjection. (TCO)

**17677** RADIOACTIVE ISOTOPES: ORIGIN AND SIGNIFICANCE, WITH SPECIAL REFERENCE TO THEIR POSSIBLE USES IN MEDICINE. H. F. Mueller (Städische Krankenanstalten, Mannheim, Ger.). Mater. Med. Nordmark, 13: 304-15(July 1961). (In German)

**17678** THE ROLE OF FORWARD MEDICAL SUPPORT IN HANDLING MASSES OF CASUALTIES IN ACTIVE NUCLEAR WARFARE. John A. Sheedy (Office of the Surgeon General, Washington, D. C.). Military Med., 127: 147-54 (Feb. 1962).

Some facts and opinions are presented relative to the operational problem of handling situations wherein masses of casualties occur on the nuclear battlefield. To visualize this problem, a situation is assumed in which a battle group is inactivated by a nuclear weapon and initially a maximum number of living casualties would result. A hypothetical situation is envisaged in which a 20-kt nuclear weapon is detonated in an air burst near the center of formation of an infantry division deployed under combat conditions. The extent of casualties and their routing through medical units are discussed in detail. The medical and tactical considerations are outlined together with the advantages and disadvantages of each course of action. It was concluded that under the conditions of active nuclear warfare, situations resulting in masses of casualties can be anticipated. (TCO)

**17679** RADIODIAGNOSIS, RADIOTHERAPY, AND RADIATION PROTECTION—1961. I. F. Ekert (Krankenhaus rechts d. Isar, Munich). Muench. Med. Wochschr., 103: 378-84(Feb. 1961).

A review of the literature for 1961 is presented. (H.H.D.)

**17680** CARCINOGENESIS AND CANCER PREVENTION. P. R. J. Burch (Univ. of Leeds, Eng.). Nature, 197: 1145-51(Mar. 23, 1963).

The roles of gene mutation, viruses, hormones, and immune reactions in malignant transformation are discussed. The possibility of limiting the incidence of postzygotic can-

cer is considered theoretically. The possible biological consequences of cancer elimination are considered. (55 references.) (C.H.)

**17681** LEUKEMIAS INDUCED IN RATS BY EXTRACTS FROM HUMAN LEUKEMIC TISSUE. A. I. Ageenko (Moscow Univ.). Neoplasma, 8: 131-43(1961). (In English)

Saline extracts of organs of patients dying of leukemia were injected in 1- to 6-day-old rats, some of which were x irradiated or treated with cortisone. Leukemia developed in 11% of 205 injected untreated rats, after an average latent period of 17 months. None of 225 rats injected with heated extracts or tissue extracts of normal patients developed leukemia. Rats injected with leukemic extracts and irradiated with 2 doses of 100 r each given 1 week apart or one 150-r dose showed a higher incidence of leukemia (19%, after an average latent period of 11 months). Injected, cortisone-treated rats showed an incidence of 14% and latent period of 15 months. Irradiation or cortisone treatment alone did not induce leukemia. The leukemia was of the myeloid type, and reticulosis was most prevalent in the irradiated group. Subcutaneous sarcoma and reticulosarcoma of liver were also frequently noted. (H.H.D.)

**17682** EXPERIENCE WITH INTRACAVITARY TREATMENT WITH COLLOIDAL RADIOGOLD. Š. Hupka, Š. Šimko, J. Siracký, and A. Skupenová (Oncological Research Inst., Bratislava). Neoplasma, 8: 295-303(1961). (In English)

The technique of intraperitoneal injection of $Au^{198}$ is described and a lead-shielded apparatus for carrying out the infusion, and which protects the operator from radiation, is illustrated. Dose distribution is also considered from a theoretical viewpoint and examined by scintillometry. The relation of the dose (D) delivered to the peritoneum to the thickness of the fluid layer containing $Au^{198}$ was expressed as: $D = 3.75 \times 10^4 \times S/V \times F$, where S is the amount of $Au^{198}$ injected in mC, V the volume of injected solution, and F a factor determined by the thickness of the layer. D reaches a maximum at a thickness of ~4 mm, and would be ~7100 r after injection of 100 ml containing 100 mC. It was estimated that $\gamma$ radiation would account for 10% of the $\beta$ dose. In the treatment of cancer patients to diminish ascites, 100 to 150 mC of $Au^{198}$ injected in 40 to 75 ml resulted in leukopenia, anorexia, and vomiting but an 80 mC dose did not influence blood cells or produce subjective symptoms. (P.C.H.)

**17683** NEW COLLIMATORS AND ISODOSES FOR THE GAMMA RADIATION APPARATUS GUT-Co-400-1. J. Ďurkovskii, V. Eichnerová, and I. Kuzma (Oncological Research Inst., Bratislava). Neoplasma, 8: 315-21(1961). (In German)

Four collimators for use with a $Co^{60}$ cell are described and the isodose distribution patterns are illustrated. The collimators consist of a 7-cm sheet of lead enclosed in a Duraluminum housing. Examples are cited showing a reduction of the skin dose during therapy of abdominal carcinomas. (H.H.D.)

**17684** THE PREPARATION OF A CONTRAST SUSPENSION WITH $Y^{90}$ FOR THERAPEUTIC USE. M. Zaduban, M. Pivoňka, and M. Klvaňa (Šafárik Univ., Košice, Czechoslovakia). Neoplasma, 8: 439-44(1961). (In German)

An investigation was made of various media to be used for implantation of therapeutic concentrations of a radioisotope in body cavities and subcutaneously. A radiopaque constituent was added so that the localization of the injected material could be visualized radiographically. The ingredients consisted of serum albumin (20%), olive oil, Mesocain (2%), Urografin (76%), and $Y^{90}$ (as $Y_2O_3$). The suspension (~6 ml, containing 20 mC) was injected at various sites in rabbits and observed radiographically. In this way it was possible to calculate the absorbed radiation dose. No untoward side effects were noted. (H.H.D.)

**17685** THE PROBLEM OF THE EVALUATION OF RADIOCURABILITY OF CARCINOMA COLLI UTERI. J. Siracký (Oncological Research Inst., Bratislava). Neoplasma, 8: 523-9(1961). (In English)

Cytologic examinations were made at various periods following radiotherapy of 50 cases of uterine cervical carcinoma. All were grade I or II epidermoid carcinomas and were treated by combined radium and deep x-ray therapy. Curettage 3 months later revealed cancer cells in 7 cases. In 5 of the 7, subsequent treatment proved the cancer cells to be radioincurable. In the other 2 cases, the tumors appeared to be eliminated by radiotherapy although cytologic evidence of the tumors persisted for several months after successful radiation treatment. (H.H.D.)

**17686** ON THE PROBLEM OF HISTOCHEMICAL TESTING OF RADIOSENSITIVITY OF CARCINOMA OF THE UTERINE CERVIX. J. Siracký (Oncological Research Inst., Bratislava). Neoplasma, 8: 531-6(1961). (In English)

Cytochemical tests were used in attempts to correlate the results with the radiosensitivity of 45 cervical carcinomas of the epidermoid type. Periodic acid-Schiff staining and alkaline phosphatase activity of the tumor both increased after treatment (radium and x radiation) but the changes were similar in radiosensitive and radioresistant tumors. DNA content, as seen by Feulgen stained preparations, declined to a greater degree in radiosensitive than resistant tumors. The greatest degree of correlation with radiosensitivity was found with RNA in methyl green-pyronine-orange G stained sections. RNA content increased in radiosensitive cells and decreased in cells that later proved resistant to radiotherapy. It is emphasized that radiosensitivity is not synonomous with radiocurability of a tumor. In some instances, apparently, radiosensitive tumors disappeared but recurred as radioincurable lesions, whereas, in other cases, cancer cells persisted after radiotherapy as seen by cytologic examination but the tumors did not recur. (H.H.D.)

**17687** THE USE OF A WEDGE-SHAPED FILTER WITH THE GUT 400 TELEGAMMA APPARATUS. A. Kubat and S. Patocka (Charles Univ., Prague). Neoplasma, 9: 209-11 (1962). (In German)

The construction of a filter for use with a $Co^{60}$ cell is described and the isodose distribution obtained with it is provided. (H.H.D.)

**17688** PRESENT KNOWLEDGE ON THE USE OF RADIOISOTOPES AND IONIZING RADIATION IN ENTOMOLOGY. V. Figura (Ufficio d'Igiene e Sanità del Comune, Rome). Nuovi Ann. Ig. Microbiol., 12: 156-70(Mar.-Apr. 1961).

**17689** DNA SYNTHESIS AS A MARKER IN FRACTIONATED RADIATION THERAPY. Frank R. Hendrickson and Howard Skypeck (Presbyterian-St. Luke's Hospital, Chicago). Radiology, 80: 244-50(Feb. 1963).

Exposure to ionizing radiations produces a marked suppression on DNA synthesis by mouse tumor. This is predominantly due to a decrease in the number of cells in the synthesis phase. This suppression lasts several days and is followed by a recovery and rebound on the third to the fifth day. Human tumors show a similar cycle change after irradiation. Normal intestinal mucosa follows a

similar suppression-recovery rebound pattern but with a shorter interval. The possibility of increasing effect by synchronizing radiation exposures with the rebound phase is suggested. (auth)

**17690** IRRADIATION AND ANTICOAGULANT THERAPY TO PREVENT PULMONARY METASTASES OF THE V2 CARCINOMA IN RABBITS. Eugene E. Cliffton and Domenico Agostino (Sloan-Kettering Inst. for Cancer Research, New York and Cornell Univ., New York). Radiology, 80: 236-43(Feb. 1963).

Irradiated cancer cells disappeared from the circulating blood in rabbits more quickly than nonirradiated cancer cells. Irradiation of cancer cells with 1,000 r did not alter significantly the growth potential of these cells. Single doses of heparin or fibrinolysin reduced the production of pulmonary metastases by both irradiated and nonirradiated cells. The decrease was greatest with the irradiated cells. Heparin and fibrinolysin administered daily for six days after the intravenous inoculation of irradiated cancer cells markedly reduced the occurrence of pulmonary metastases. (auth)

**17691** MERCURY 203 BRAIN SCANNING. A METHOD OF CLINICAL CLASSIFICATION. Kenneth D. McGinnis, William R. Eyler, Lucille Du Sault, and Karl Kristen (Henry Ford Hospital, Detroit). Radiology, 80: 264-6 (Feb. 1963).

Localization of $Hg^{203}$-labeled Neohydrin in studies of the brain has been demonstrated in various non-neoplastic processes and the scan configuration has shown certain distinguishing features. By using the principles of classification suggested, useful information concerning non-neoplastic abnormalities was obtained. Accuracy of scans compares favorably with other neuroradiological procedures, without their attending morbidity. (auth)

**17692** CLINICAL AND PHYSICAL ASPECTS OF ELECTRON BEAM THERAPY. R. J. Schulz, Sidney Schultz, and Charles Botstein (Montefiore Hospital, New York). Radiology, 80: 301-3(Feb. 1963).

The reading of a Victoreen dosimeter, in r, and the RBE dose, in rems, may differ by a factor as large as 1.52. The RBE of 35-Mev-electrons, on the basis of the LD 50/30 days for C57L/J mice was determined to be 0.79. There appears to be no difference in the RBE of electron beans at the surface as compared with depth, at least down to that level corresponding to the 60 per cent isodose curve. High energy electron beams appear to be a valuable treatment modality for a number of reasons. There is excellent tissue recovery even when doses are corrected by the above-mentioned factors. Tumor response is as good as, if not better than, with conventional equipment. Uniform dose distributions, lower integral doses, and controlled depth dose are obtained. (auth)

**17693** IMAGE SEPARATION RADIOISOTOPE SCANNING. David E. Kuhl and Roy Q. Edwards (Univ. of Pennsylvania, Philadelphia). Radiology, 80: 653-62(Apr. 1963).

Equipment and procedures are described that were used in laboratory investigations of image separation during radioisotope scanning. Phantoms with radioactive sources distributed between different planes were used. Results are reported for rectilinear scanning, sterioscopic scanning, and section scanning. Photographic recordings demonstrate accurate cross-section images of the radioactive sources in the phantom. It was concluded that body-section radiographic principles can be applied to the problem of $\gamma$ ray image formation in medical radioisotope scanning. (C.H.)

**17694** THE CONSTRUCTION OF RADIOCARBON ASSIMILATION CHAMBER. Azuma Okuda (Kyoto Univ.). Radioisotopes (Tokyo), 12: 18-25(Feb. 1963). (In Japanese)

For the study of plant physiology, such as carbon assimilation, respiration, translocation, and path of assimilated carbon, it is necessary to put the plant in a chamber containing $CO_2^{14}$ and take out the plant safely and easily. A specific growth chamber for $CO_2^{14}$ assimilation was constructed for such studies. This growth chamber consists of one main chamber and one side chamber with stainless steel frames. The main chamber is 1 meter square and 1.8 meters in height. Connected with the main chamber are the following associated units; a monitor unit consisting of an infrared gas analyzer and a "carbon counter," which have a special detector consisting of gas flow counter tube having thin aluminium foil; a regulator unit of thermostat and humidistat; a carbon dioxide absorbing unit; a plastic bag for buffering change of pressure; and equipment to generate $CO_2^{14}$. Each unit is connected with the growth chamber by plastic pipelines. The temperature inside the chamber can be regulated within the range ±20°C from atmospheric temperature with a variation of ±2°C. The humidity also can be regulated to any humidity within the range of 40 to 90% with a variation of ±10%. The round plate set in the floor of the main chamber can be set to turn to supply equal light to plants on the plate in the chamber. Temperature, humidity, and concentrations of carbon dioxide and radioactivity of $CO_2^{14}$ are recorded on auto-recorders. The maximum leakage of gas from the chamber and various units was under 3%. Some experimental data with several kinds of higher plants were also presented. This chamber is mainly for the study of plant physiology, but also can be used for the production of labeled plant materials. (auth)

**17695** A $^{32}P$ BETA-RAY APPLICATOR UTILIZING AGAR-AGAR. Chikara Takei and Satomi Hakariya (Nagasaki Univ.). Radioisotopes (Tokyo), 12: 55-9(Feb. 1963). (In Japanese)

A $P^{32}$ beta ray applicator consists of a thin film of agar-agar, that, after dissolving a certain amount of $P^{32}$, is coagulated and cut into a shape conforming to the skin lesion to be treated. This provides a uniformly distributed radioactivity that can be attached closely to the affected skin. (C.E.S.)

**17696** RADIOBIOLOGY AND MEDICINE. Eberhard Loehr (Max-Planck-Institut für Biophysik, Frankfurt am Main). Roentgen- Lab. Praxis, 14: R113-19(May 1961).

**17697** A NEW METHOD OF ESTIMATING FORWARD MUTATION IN FUNGI: RESISTANCE TO 8-AZAGUANINE AND p-FLUOROPHENYLALANINE. G. Morpurgo (Istituto Superiore di Sanita, Rome). Sci. Rept. Ist. Super. Sanita, 2: 9-12(1962). (In English)

Resistance to 8-azaguanine and p-fluorophenylalanine (p-FP) constitutes a very good forward mutation test in Aspergillus and Penicillium. The mutations occur at a rate up to 2 in $10^3$ of the surviving conidia after ultraviolet irradiation, and turn out to be recessive in heterozygous diploids. The majority of the p-FP-resistant mutants are tyrosine requiring and all are allelic as determined by diploid tests. (auth)

**17698** THE STATUS OF X RAYS USED FOR MEDICAL PURPOSES IN ARTIFICIAL IRRADIATION OR THE DANGERS OF AN EXCESSIVE RADIOPHOBIA. Roland Buchet and Jacques Lafay. Semaine Med. Profess. Med.-Soc., 37: 78-81(Feb. 2, 1961).

A review. (H.H.D.)

**17699** THE PLACE OF RADIATION IN MODERN TUMOR MANAGEMENT. Robert D. Sloan and Bernard T. Hickman (Univ. of Mississippi, Jackson). Surg. Clin. North Am., 42: 403-17(Apr. 1962).

Basic concepts of radiotherapy are reviewed, including the nature of the ionizing radiations used, effect of radiation on normal and malignant cells, and dosimetry. Recent advances in radiation equipment and sources are discussed in relation to their application to specific clinical problems. Radiosensitivity of various kinds of neoplasms is discussed and the most effective types of radiotherapy for tumors originating in different organ systems are outlined. (H.H.D.)

**17700** MEDICAL PROBLEMS IN RELATION TO THE USE OF ATOMIC ENERGY. L. Carlbom, L. Engstedt, K. G. Luning, A. Norden, and A. Swensson (Karolinska Sjukhuset, Stockholm). Svenska Lakartidn., 58: 2543-74 (Sept. 15, 1961). (In Swedish)

**17701** PROPHYLACTIC VACCINATION WITH VACCINES OF BACTERIA INACTIVATED BY X IRRADIATION. Heinz Beutel (Universität, Munich). Zentr. Bakteriol., Parasitenk., Abt. I. Orig., 187: 90-9(1962).

Mouse protection tests were conducted with vaccines prepared from Brucella abortus or Listeria monocytogenes by means of x rays or formaldehyde. B. abortus (Buck 19 strain) was killed by irradiation with 50-kv x rays while suspended in saline solution. The absolute sterilizing dose for $10^{10}$ bacteria was 1.5 Mr. Vaccine prepared in this way, or by treatment with HCHO at a concentration of 0.2%, was injected with $Al(OH)_3$ in mice. When the mice were subsequently challenged with living bacteria, the survival rate was 43% in mice immunized with radioinactivated vaccine, 30% in those given formalized vaccine, and 0% in unvaccinated controls. Vaccines were similarly prepared and tested using L. monocytogenes, except the x-ray sterilizing dose was 1.0 Mr. With both irradiated and formalized vaccines the survival rate of challenged mice was 5%, compared with 0% in unvaccinated controls. Although the results indicate that there is little difference between the protection afforded by vaccines prepared with x rays or HCHO, the irradiated vaccines were somewhat better tolerated by the mice than formalized vaccines. (H.H.D.)

**17702** STRAHLENBIOLOGIE, STRAHLENTHERAPIE, NUCLEARMEDIZIN, UND KREBSFORSCHUNG: ERGEBNISSE 1952-1958. (Radiation Biology, Radiation Therapy, Nuclear Medicine, and Cancer Research: Results 1952-1958). H. R. Schinz, H. Holthusen, H. Landendorff, B. Rajewsky, and G. Schubert, eds. Stuttgart, Georg Thieme Verlag, 1959. 998p. (DM 275)

**17703** LA CINETICA DEI FARMACI E DEI TRACCIANTI RADIOATTIVI. (The Kinetics of Drugs and Radioactive Tracers). Aldo Rescigno and Giorgia Segre. Turin, Paolo Boringhieri, 1961. 213p.

A study, designed for the Italian scientific public operating in the field of the biological discipline, is presented on the kinetics of drugs and radioactive tracers. The absorption, elimination, and distribution curves of drugs and tracers are first considered in principle. Basic concepts are further discussed with a review of compartmentation and dynamic equilibrium between compartments and systems. The synthesis of a model from the experimental data is described, and the theory of the compartmented system model is given. Turnover and precursors, directly connected with the compartmental theory, are treated by applying the same methods used in the study of the models. 183 references. (J.S.R.)

**17704** METHOD OF SUPPRESSING GASTROINTESTINAL UREASE ACTIVITY. Willard J. Visek (to U. S. Atomic Energy Commission). U. S. Patent 3,086,864. Apr. 23, 1963.

This patent shows a method of increasing the growth rate of chicks. Certain diacyl substituted ureas such as alloxan, murexide, and barbituric acid are added to their feed, thereby suppressing gastrointestinal urease activity and thus promoting growth. (AEC)

## Biochemistry, Nutrition, and Toxicology

**17705** (HW-SA-2737) RADIOISOTOPES IN THE BODY—DIAGNOSIS AND TREATMENT. W. D. Norwood (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). [Aug. 28, 1962]. Contract AT (45-1)-1350. 10p.

With increasing use of radioisotopes, the opportunity for deposition within the body is increasing. Methods for the early detection and treatment for such deposition are outlined. (auth)

**17706** (PG-Report-424) ANALYTICAL METHOD FOR THE DETERMINATION OF SODIUM AND POTASSIUM IN BLOOD SERUM (FLAME PHOTOMETRY). (United Kingdom Atomic Energy Authority. Production Group, Windscale, Sellafield, England). 1963. 4p.

A standard method is described for the determination of Na and K in blood serum samples. After suitable dilution with HCl the Na and K are determined by flame photometry. The precision (3 times standard deviation) is estimated as not worse than ±10% for concentration ranges of Na: 2 to 5 mg/ml and K: 50 to 500 mg/ml. (auth)

**17707** (JPRS-18492) HYGIENE AND SANITATION. Translations from Gigiena i Sanitariya, 28: No. 1, 53-5; 83-9; 95-9; 105-8(1963). 36p. (OTS-63-21475)

A translation is presented of 5 articles from Gigiyena I Sanitariya (Hygiene and Sanitation), Vol. 28, No. 1, 1963. Separate abstracts were prepared for 4 of the articles. The remaining paper was "Changes in the Nasal Mucous Membrane Upon Adaptation to Cold in the North." (M.C.G.)

**17708** (JPRS-18492(p.1-4)) PROBLEM OF INDIVIDUAL DOSIMETRIC CONTROL METHODS. G. A. Zubovskii (Zubovskiy) and M. A. Sobolevskii (Sobolevskiy). Translated from Gigiena i Sanit., 28: No. 1, 53-5(1963).

It is suggested that the system of individual dosimetry be changed by conducting control determinations not daily, but weekly. A check was made of 200 individual dosimeters to test their correspondence to technical requirements. Errors due to self-discharge and incorrect setting of central electrodes are described and methods to avoid them outlined. (M.C.G.)

**17709** (JPRS-18492(p.5-16)) THE PROBLEM OF DETERMINING THE MAXIMUM PERMISSIBLE LEVELS OF STRONTIUM-90 CONTENT IN FOOD PRODUCTS. P. P. Lyarskii (Lyarskiy) and A. A. Moiseev. Translated from Gigiena i Sanit., 28: No. 1, 83-9(1963).

It is shown that a correct hygienic evaluation of the results of radiochemical and radiometric determinations of $Sr^{90}$ in food products can be based only on their comparisons with the maximum permissible limit (MPL) magnitudes. Data are reviewed on $Sr^{90}$ contents in foods. It was concluded that the method of calculation of the MPL of $Sr^{90}$ in food products, based on the evaluation of calcium present in the food is more correct than other methods of calculation. (M.C.G.)

**17710** (JPRS-18492(p.17-19)) COMMENTS ON SANITARY RULES OF WORK WITH RADIOACTIVE SUB-

STANCES AND SOURCES OF IONIZING RADIATION. A. P. Denisov. Translated from Gigiena i Sanit., 28: No. 1, 95-6(1963).

Additions, changes, and clarifications are suggested for the sanitary rules of work with radioactive materials and sources of ionizing radiation that were published in 1960. (M.C.G.)

**17711** (JPRS-18492(p.26-33)) PASSAGE OF STRONTIUM-90 FROM MILK TO VARIOUS DAIRY PRODUCTS DURING VARIOUS TECHNOLOGICAL PRODUCTION PROCESSES. Z. V. Dubrovina and O. M. Belova. Translated from Gigiena i Sanit., 28: No. 1, 105-8(1963)

Determinations were made of the relative passage of calcium, stable strontium, and $Sr^{90}$ from milk during standard processing to cream, skimmed milk, casein, butter, and butter milk and of the relative passage of calcium and $Sr^{90}$ to cottage cheese, cheese, and casein during their preparation. The absolute content of $Sr^{90}$ was not uniform in the various products; it was highest in casein and lowest in cream. The relative content of $Sr^{90}$ per g of calcium and mg of stable strontium was almost uniform in all dairy products. The activity from $Sr^{90}$ in cottage cheese and cheese is higher than in the milk. Only 4 to 5% $Sr^{90}$ passes from milk to cream and less than 1% to butter. (M.C.G.)

**17712** THE INFLUENCE OF METHIONINE SULFOXIMINE ON THE LIVER AND SPLEEN OF RATS. J. Koloušek, Zd. Dienstbier, and Č. Michalec (Charles Univ., Prague). Acta Univ. Carolinae Med., Suppl., 14: 95-102 (1961). (In Czech.)

Studies were made of the influence of DL-methionine sulfoximine on the incorporation of $S^{35}$ in the protein, nonprotein, and lipid fractions of liver and on the urinary excretion of $S^{35}$ in rats. Stimulation of methionine-$S^{35}$ uptake by spleen occurred 6 hr after treatment with methionine sulfoximine and persisted after 24 hr, whereas in liver the stimulation was slight. A single intraperitoneal injection of 400 mg/kg methionine sulfoximine produced fatty degeneration of liver. In contrast, in spleen it resulted in a decrease in total lipid, phospholipid, and esterified fatty acid content. The injection also produced changes in blood cell counts, which were simulated by x irradiation of the rats with 50 r. Moreover, both x irradiation and injection of methionine sulfoximine caused an increase in the urinary excretion of Dische-positive substances, presumably catabolites of DNA. In rats irradiated with 600 r and injected 1 hr later with methionine-$S^{35}$, a radioinduced rise in urinary excretion of $S^{35}$, which paralleled the increase in excretion of Dische-positive substances, was noted. A similarity in the mechanism of action of methionine sulfoximine and ionizing radiation is suggested. This compound was also found to decrease the incorporation of $P^{32}$ in cytoplasmic RNA 59%. (P.C.H.)

**17713** INCREASED RUBIDIUM UPTAKE BY RED CELLS DURING PREGNANCY. Jerold M. Lowenstein (Children's Hospital, San Francisco). Am. J. Physiol., 203: 1191-2(Dec. 1962).

The avidity of red cells for $Rb^{86}$, a tracer of potassium in biological systems, was measured before, during, and after pregnancy. There was a gradual rise in rubidium uptake throughout pregnancy. The average uptake at 8 months' gestation was 50% higher than control levels; 6 weeks post-partum the uptake had decreased, but not to the control value. (auth)

**17714** THE UPTAKE, DISTRIBUTION, AND EXCRETION OF FOUR RADIONUCLIDES IN AUSTRALORBIS GLABRATUS (PLANORBIDAE). Charles R. Johnson, Charles R. Angel, and Duane G. Erickson (U. S. Army Tropical Research Medical Lab., New York). Am. J. Trop. Med. Hyg., 11: 855-60(Nov. 1962).

Radioisotopes ($Sr^{85}$, $Fe^{59}$, $Rb^{86}$, $Na^{22}$) were incorporated into media in which the snail was growing. The uptake, distribution, and degradation of each of the nuclides were studied. The order of uptake, expressed as per cent mean uptake, was Sr > Fe > Rb > Na. The mean per cent uptake for the 4 nuclides at the end of the uptake study was 71% for Sr, 16% for Fe, 4.0% for Rb, and 1.4% for Na. A study of the effect of increasing specific activity on the distribution of each of the 4 nuclides between tissue and shell showed that tissue radioactivities are linear for $Sr^{85}$, $Fe^{59}$, and $Rb^{86}$ but not for $Na^{22}$. Uptake of the nuclides into dead shells (by passive adsorption) decreased in the order Fe > Na > Rb > Sr. Autoradiography of snails treated with the 4 radionuclides is illustrated. $Fe^{59}$ is localized in specific areas difficult to differentiate anatomically. $Na^{22}$ and $Rb^{86}$ are uniformly distributed in the soft tissue of the snail with little uptake into the shell. The deposition of $Sr^{85}$ in the tissue is generalized while in the shell it is localized almost exclusively in the newly formed portions. The results thus show that appreciable quantities of $Sr^{85}$ and $Fe^{59}$ are concentrated by Australorbis. At day 15 of the uptake study, the radioactivity of snails maintained in water containing $Sr^{85}$ was 700 times that of the water. For $Fe^{59}$ the concentration ratio was 270. The concentration ratios compare favorably with those observed for the marine clam. The application of radioactive tagging to field studies of the ecology and population dynamics of snail intermediate hosts of parasitic diseases is proposed. (TCO)

**17715** CHRONIC BERYLLIUM INTOXICATION TREATED WITH CORTICOSTEROIDS AND CORTICOTROPIN. Benjamin G. Ferris, Jr. (Harvard School of Public Health, Boston). Am. Rev. Respirat. Diseases, 85: 583(Apr. 1962).

Four patients with chronic beryllium intoxication were studied in order to test 4 hypotheses proposed for a decrease in pulmonary function as indicated by increased alveolar-arterial oxygen difference, although clinically the patients were improved. All showed relatively little change in pulmonary function when treated orally with increased amounts of corticosteroids, and 2 who received intramuscular corticotropin showed no improvement in pulmonary function. The results indicated that the most likely explanation for the failure of prolonged therapy is that there may be 2 stages in the pulmonary disease associated with chronic beryllium intoxication; the first is reversible by treatment and is characterized by round-cell infiltration and noncaseating granulomas; the second is irreversible and does not respond to treatment, possibly due to fibrotic changes in the lungs. Postmortem studies confirmed the irreversibility of fibrotic pulmonary changes. (TCO)

**17716** THE CATABOLISM OF HEXOBARBITAL IN VIVO IN THE WHOLE-BODY IRRADIATED MOUSE. D. Winne (Medizinische Forschungsanstalt der Max Planck Gesellschaft, Göttingen, Ger.). Arch. Exptl. Pathol. Pharmakol., 243: 546-53(1962).

In mice x irradiated with 700 r, the catabolism of injected hexobarbital was significantly depressed when tested on the 5th and 7th postirradiation days. The respective elimination constants (calculated by multiplying the regression coefficient by 1/log e) were −0.0067 and −0.0059 $min^{-1}$, in contrast to the value in unirradiated mice of −0.0148, which corresponds to a 59% decline in the concentration of hexobarbital 1 hr after injection.

On the other hand, catabolism of hexobarbital was accelerated on the 8th and 14th days after 400-r whole-body irradiation; the corresponding elimination coefficients were $-0.0180$ and $-0.0217$ $min^{-1}$. Hexobarbital catabolism was also accelerated above the control level when the mice were pretreated with hexobarbital and then tested 5 days after 700-r irradiation (elimination constant = $-0.0170$ $min^{-1}$). Since the degradation of hexobarbital depends upon its demethylation and oxidation in liver microsomes, it was concluded that the organelles are injured by irradiation. (H.H.D.)

**17717** THOROTRAST EFFECT ON VASOMOTOR CHANGES OF SHWARTZMAN REACTION. Ting-Chao Wong, Michael Galton, and Donald G. McKay (Columbia Univ., New York). Arch. Pathol., 72: 280-9(Sept. 1961).

Glomerular capillary dilation occurred after one dose of endotoxin in rabbits prepared with Thorotrast (colloidal solution of $ThO_2$). Glomerular capillary dilation was not due to fibrin deposition, since it occurred prior to and sometimes in the absence of fibrin deposits. It is suggested that glomerular capillary dilation is the factor responsible for localizing fibrin thrombi in the kidney during the generalized Shwartzman reaction. Thorotrast by itself is incapable of producing intravascular thrombosis and substituting for endotoxin as the provoking dose, and therefore is incapable of producing the generalized Shwartzman reaction. The reason for the difference in the action of Thorotrast as compared with endotoxin, which will both prepare and provoke, may be the inability of Thorotrast to induce in vivo intravascular coagulation. Thrombi are seldom seen in the spleen and liver after Thorotrast, whereas after endotoxin preparation they are common in these organs. (H.H.D.)

**17718** MOVEMENT OF STRONTIUM IN THE HUMAN BODY. T. E. F. Carr, G. E. Harrison, J. F. Loutit, and Alice Sutton (Medical Research Council, Harwell Berks, Eng.). Brit. Med. J., 2: 773-5(Sept. 22, 1962).

The replacement of body strontium was investigated in single-dose experiments by injecting $Sr^{85}$ (0.5 $\mu$C), a $\gamma$-emitter, intravenously into 2 normal subjects and following its loss from plasma for 2 days, its excretion for 4 months, and, with a whole-body counter, its retention for 1 year. Retention was not expressed as a simple exponential function but presumably the sum of many. After a few weeks it could be expressed as a power-function. From the loss of $Sr^{85}$ from plasma in the first week it was possible to deduce an exchangeable pool of about 2.75 mg of Sr and clearance into bone of 0.4 mg/day. However, the 0.4 mg/day value was not used to calculate turnover, because while the calculation is valid for exchange mechanisms it may not be applicable to osteogenesis. About 85% of the injected isotope was excreted within the year; the remaining 15% was retained in definitive, as distinct from temporary, bone. Normally about 20% of dietary Sr (about 2 mg/day in the United Kingdom) is absorbed. Therefore replacement of Sr in bone is about $0.2 \times 2 \times 365 \times 0.15 = 22$ mg/yr. In daily-dose experiments, 3 human subjects ingested 0.5 $\mu$C of $Sr^{85}$ daily for a month. Equilibrium was established within a week, when plasma levels were constant: 3, 7, and 3 m$\mu$C/l, respectively; and daily urine excretions were constant: 25, 60, and 50 m$\mu$C/day, so that renal clearances from plasma were approximately: 8, 8, 17 l/day. Balances in the second to fourth weekly periods indicated a final retention of ~6% of ingested isotope. Estimates of the annual rate of replacement in the adult are only a few per cent per year, when calculated from long-term ingestion of $Sr^{90}$, somewhat more according to short-term experiments involving ingestion of $Sr^{85}$ for a month, and much less than the total turnover of bone mineral. (P.C.H.)

**17719** COMPARATIVE GENERAL TOXICITY OF METALLIC IONS. RELATION WITH THE PERIODIC CLASSIFICATION. Pierre Bienvenu, Claude Nofre, and André Cier (Centre de Recherches du Service de Santé des Armées, Lyon). Compt. Rend., 256: 1043-4(Jan. 21, 1963). (In French)

The acute toxicities of 42 cations were evaluated, after intraperitoneal injection in the mouse, by the $LD_{50}$ at the thirtieth day. The ions studied were Na(I), Li(I), Rb(I), $NH_4$(I), Cs(I), K(I), Sr(II), Mg(II), Ca(II), H(I), ZrO(II), Cr(III), Th(IV), Mn(II), Al(III), Fe(II), Y(III), Sc(III), Pd(II), La(III), Fe(III), Ce(III), Pb(II), Co(II), Sn(II), Ir(IV), VO(II), Ba(II), Ga(III), Zn(II), Sn(IV), Au(III), Be(II), Ni(II), Ag(I), Tl(I), Pt(IV), Cu(II), Cd(II), In(III), $UO_2$(II), and Hg(II). The results show there is a periodicity of the toxicity values, as a function of the atomic number, analogous to that of the periodic system. (tr-auth)

**17720** TRACE ELEMENTS IN HUMAN TISSUE. PART I. METHODS. I. H. Tipton (Univ. of Tennessee, Knoxville), M. J. Cook, R. L. Steiner, C. A. Boye, H. M. Perry, Jr., and H. A. Schroeder. Health Phys., 9: 89-101 (Feb. 1963).

The concentrations of trace elements in normal tissues and the distribution of these elements throughout the body were determined by emission spectroscopy. The methods of collection and preparation of samples, of spectrographic analysis, and of statistical treatment of data are described. (auth)

**17721** TRACE ELEMENTS IN HUMAN TISSUE. PART II. ADULT SUBJECTS FROM THE UNITED STATES. Isabel H. Tipton (Univ. of Tennessee, Knoxville) and M. J. Cook. Health Phys., 9: 103-45(Feb. 1963).

Central values and an estimate of the variation about the central values are given for 24 trace elements and the dry, and ash content of samples of 29 different tissues of 150 adult victims of instantaneous death who had spent their lives in the United States. (auth)

**17722** THE ASSAY OF TOTAL POTASSIUM IN THE HUMAN BODY. P. Delwaide, W. G. Verly, J. Colard, and R. Boulenger (Universite, Liége and Centre d'Etude de l'Energie Nucléaire, Mol, Belg.). Health Phys., 9: 147-52 (Feb. 1963).

Total potassium of ten human subjects was determined by gamma spectrometry following the method of Miller and Marinelli. Preliminary in vitro trials have given an estimation of the different factors influencing the accuracy of the result. With $K^{42}$ standardization, the results are reproducible with an error of 3.2 per cent. But this standardization introduces conditions which make clinical applications difficult. A detector with a nearly $4\pi$ geometry is described which is formed of a hollow plastifluor cylinder with the photomultipliers located at the end in a crown arrangement. (auth)

**17723** THORIUM DISTRIBUTION AND EXCRETION STUDIES. I. PATTERNS FOLLOWING PARENTERAL ADMINISTRATION. Robert G. Thomas, Randi Lie, and James K. Scott (Univ. of Rochester, N. Y.). Health Phys., 9: 153-63(Feb. 1963).

The distribution and excretion patterns of thorium administered in the citrated form to the rat were determined after four routes of injection. These routes are intravenous (IV), intramuscular (IM), intraperitoneal (IP), and intratracheal (IT). Two levels of thorium (thorium-234 and thorium-232) were used in the injections, one at a dose of

$5.5 \times 10^{-6}$ g thorium per kg body weight and the other at $6.4 \times 10^{-3}$. Thorium at the higher level appeared to be more insoluble and of a particulate nature, either concentrating in tissues of the reticuloendothelial system or depositing in the tissue into which it was introduced (i.e. lung (IT), muscle (IM)). At the lower ("tracer") level, deposition was greater in bone (per g) than in other tissues, with the lung after IT injection being very nearly equal to it. The choice of a "critical" organ is clearly a function of the route of entrance to the body and of the concentrations of thorium involved. The pattern of deposition in the skeleton as a function of the level of thorium administered is discussed using data of several investigators from IV administration to rats. (auth)

**17724** THORIUM DISTRIBUTION AND EXCRETION STUDIES. II. GENERAL PATTERNS FOLLOWING INHALATION AND THE EFFECT OF THE SIZE OF THE INHALED DOSE. Bruce B. Boecker, Robert G. Thomas, and James K. Scott (Univ. of Rochester, N. Y.). Health Phys., 9: 165-76(Feb. 1963).

A series of single, short-term inhalation exposures of rats to thorium chloride aerosols was conducted to study thorium distribution and excretion patterns and the effect of the size of the initial lung thorium burden on these patterns. Soon after exposure, a fraction of the thorium in the lungs was absorbed into the body and the largest portion of this absorbed fraction was deposited in the skeleton. Following this initial uptake, the organ thorium burdens remained approximately constant while the lung burden decreased with time after exposure accompanied by excretion of thorium predominantly in the feces. The fraction of the lung thorium burden that was absorbed and the fractions excreted in the urine and feces did not appear to be affected by a variation in the size of the initial lung burden by a factor of $1.1 \times 10^5$. Calculations of the $(MPC)_a$ values based on these data yielded a value of $1 \times 10^{-11}$ $\mu c/cm^3$ for both soluble and insoluble natural thorium and soluble $Th^{232}$ compounds. The corresponding value for insoluble $Th^{232}$ compounds was found to be $2.5 \times 10^{-11}$ $\mu c/cm^3$. (auth)

**17725** SEPARATION OF $I^{131}$-LABELLED PROTEIN-BOUND INSULIN FROM "FREE" INSULIN BY GEL-FILTRATION. V. Manipol and H. Spitzy (Univ. of the Philippines, Manila). Intern. J. Appl. Radiation Isotopes, 13: 647-8(Nov.-Dec. 1962). (In English)

A simple and more dependable method was devised for separating protein-bound radioinsulin from free insulin by means of gel-filtration using Sephadex G-75. Protein determination is done spectrophotometrically at 280 nm. and reproducible results are obtained. (P.C.H.)

**17726** THE EFFECT OF IONIZING RADIATION ON PROTEIN AND CARBOHYDRATE METABOLISM IN THE RAT LENS. Sidney Lerman, Anima Devi, and Renaka Banerjee (Univ. of Rochester, N. Y.). Invest. Ophthalmol., 1: 95-100(Feb. 1962).

In an attempt to elucidate some of the biochemical mechanisms which may be responsible for the pathogenesis of radiation cataract, some aspects of protein, RNA, and carbohydrate metabolism were investigated in the lenses of rats exposed to a single cataractogenic dose of x radiation (1500 r, whole-body or locally to the head). Data were obtained on $C^{14}$-leucine incorporation into the soluble and insoluble protein-RNA complex of lens. There was a marked increase in the 6-hr incorporation of leucine into the insoluble protein-RNA complex of lenses derived from both groups of irradiated rats as compared with controls. There was also a marked increase in incorporation of $P^{32}$ into the albuminoid RNA fraction from irradiated lenses as compared with control lenses. This increase was maintained for at least 24 hr after irradiation. The results of recovery of $C^{14}O_2$ from control and experimental lenses incubated with glucose-1-$C^{14}$ or glucose-6-$C^{14}$ and of the activity of glucose-6-phosphate (G-6-P) dehydrogenase showed no changes in irradiated lenses. However, there was an increase in lactate concentration of lens one week after irradiation, which returned to normal at the end of the second week. Anaerobic glycolysis was not only unaffected by radiation, but may be capable of an increased activity after exposure to radiation. It appears that there is a marked increase in the turnover of the albuminoid RNA as reflected by an increased incorporation of $P^{32}$ into this molecule, while the concentration of this RNA remains unchanged. (TCO)

**17727** ATTEMPT TO REMOVE THORIUM BY USE OF CHELATING AGENT. Roger J. Fontaine (Faulkner Hospital, Boston), Doris E. Barber, Constantine J. Maletskos, Edward W. Webster, and John R. Graham. J. Am. Med. Assoc., 184: 55(Apr. 6, 1963).

Treatments with calcium diethylenetriaminepentacetate were carried out on a 63-year-old housewife who received Thorotrast in 1947 for carotid arteriography. The treatments were intramuscular and intravenous injections given at various times, and the excretion and body burden were monitored before and after the treatments. No evidence was found for thorium removal. (D.L.C.)

**17728** ELECTRON STAINS. I. CHEMICAL STUDIES ON THE INTERACTION OF DNA WITH URANYL SALTS. C. Richard Zobel and Michael Beer (Johns Hopkins Univ., Baltimore). J. Biophys. Biochem. Cytol., 10: 335-46(July 1961).

Highly polymerized salmon sperm DNA was dissolved in aqueous solutions of uranyl acetate or nitrate, and the stoichiometry of the $UO_2^{2+}$-DNA complex was studied under varying conditions (pH, salt concentration). At pH 3.5 DNA interacts with uranyl ions in low concentration yielding a substrate metal ion complex with a $UO_2^{2+}$/P mole ratio of about $\frac{1}{2}$ and having a large association constant. At low pH's (about 2.3) the mole ratio decreases to about $\frac{1}{3}$. Destruction of the structural integrity of the DNA by heating in HCHO solutions leads to a similar drop in the amount of metal ion bound. Raising the pH above 3.5 leads to an apparent increase in binding as does increasing the concentration of the salt solution. The additional binding has a lower association constant. Under similar conditions DNA binds about 7 times more uranyl ion than bovine serum albumin, indicating useful selectivity in staining for electron microscopy. The actual nature of the ligand-substrate complex was not determined. (P.C.H.)

**17729** GAMMA IRRADIATION AND INTERRELATION OF DIETARY VITAMIN A AND COPPER ON THEIR DEPOSITION IN THE LIVER OF SWINE. R. L. Shirley, T. N. Meacham, A. C. Warnick, H. D. Wallace, J. F. Easley, G. K. Davis, and T. J. Cunha (Univ. of Florida, Gainesville). J. Nutr., 78: 454-6(Dec. 1962).

A study was made to determine whether dietary vitamin A had an effect on the level of deposition of Cu in liver; whether dietary Cu had an effect on the deposition of vitamin A in the liver; and whether whole-body gamma irradiation had any effect on the deposition of vitamin A and Cu in the liver of swine. Vitamin A unsupplemented pigs had only 2 to 3 IU of vitamin A/g fresh weight of liver. High vitamin A values (116 to 122 IU/g) in the liver of supplemented pigs demonstrated the remarkable capacity of the liver to store vitamin A when it is present in the

diet. Whole-body $Co^{60}$ irradiation with 630 r had no significant effect on the deposition of vitamin A in these tissues. Swine that received no supplemental vitamin A had a greater concentration of Cu in liver, and irradiation resulted in a greater deposition of Cu in the liver. However, dietary vitamin A and irradiation did not affect deposition of Cu in heart and gracilis muscle. Cu supplementation increased the level of vitamin A in liver, possibly on account of the effect of $CuSO_4$ in eradicating intestinal parasites. (TCO)

**17730** ZINC-65 UPTAKE BY THE PROSTATE. Rocco A. Verrilli, Luther W. Brady, Millard N. Croll, William C. Hunsicker, Jr., and Richard C. Uhlman (Hahnemann Medical Coll., Philadelphia). J. Urol., 88: 664-6(Nov. 1962).

Dogs were injected intravenously with 40 to 150 $\mu$C $Zn^{65}$, with and without injections of testosterone, and prostatic radioactivity was followed by external scintiscanning and tissue analyses. The results revealed that dog prostate concentrates $Zn^{65}$ and maintains a significant level 7 to 9 days following intravenous injection of the isotope. The preparation of dogs with testosterone alone or in conjunction with pilocarpine did not significantly alter the concentration of $Zn^{65}$ by the prostate. With external scintiscanning techniques no selective differentiation could be made between the prostate and surrounding tissue. There was no discernible pattern in the distribution of $Zn^{65}$ throughout prostatic tissue as measured by radioassay of serial tissue slices, by radioautography, or by in vitro scintiscanning of the whole gland or serial slices. Also, there was no difference in the $Zn^{65}$ uptake by prostate gland whether the carrier was $ZnCl_2$ or Zn gluconate. (P.C.H.)

**17731** THE ELIMINATION OF DEXTRAN FROM THE CIRCULATION OF THE WHOLE-BODY IRRADIATED RABBIT. Dietrich Winne and Werner Koll (Max-Planck-Gesellschaft, Göttingen, Ger.). Klin Wochschr., 39: 548-50(May 15, 1961).

Rabbits were irradiated with 1000-r doses of 250-kv x rays and 4 days later were infused intravenously with 5 ml of 6% dextran solution. One of the dextran preparations used was Macrodex; the other 2 were of a mean molecular weight of 40000 and 100000, respectively. In unirradiated animals the plasma clearance rate of Macrodex was between that of the 40000 and 100000 molecular weight dextran preparations, indicating its intermediate molecular size. The clearance rate of the dextrans was increased by irradiation, but the dextrans maintained their plasma-expander function to a large extent. Their clearance from plasma was increased by irradiation by a factor of 1.18, 1.31, and 1.15, respectively. It is suggested that the accelerated elimination of the macromolecules from the circulation results from the increase in capillary permeability induced by radiation. The findings were similar to those previously observed with Evans blue and $I^{131}$-labeled serum albumin, both of which disappeared from plasma at an increased rate in irradiated animals. (H.H.D.)

**17732** EFFECT OF FLUOROACETATE ON UPTAKE OF YTTRIUM-91 IN RABBITS. Jill Dearnaley (Churchill Hospital, Oxford). Nature, 197: 1218-19(Mar. 23, 1963).

The effect of fluoroacetate on the uptake of $Y^{91}$ in the soft tissues of rabbits was investigated. Results showed that the heart was the only organ in which an increase in citrate content could be demonstrated. No increase in $Y^{91}$ uptake was demonstrated in any of the soft organs. It was concluded that in soft tissues there is no correlation between yttrium uptake and citrate content. (C.H.)

**17733** STUDY OF THE INCORPORATION OF RADIOACTIVE PHOSPHORUS ($P^{32}$) IN THE ELEMENTS OF BLOOD UNDER THE ACTION OF X RAYS. I. INCORPORATION OF $P^{32}$ IN LEUKOCYTES OF IRRADIATED DOGS. I. Banu, L. Vlad, V. Dragon, and St. Casat (Oncology Inst., Bucharest). Neoplasma, 8: 165-75(1961). (In French)

Dogs were injected with $Na_2HP^{32}O_4$ at various intervals after 600- or 1000-r whole-body x irradiation. The uptake of $P^{32}$ by circulating leukocytes (and plasma) was expressed in terms of a biologic concentration coefficient (BCC), defined as [(cpm/$10^6$ leukocytes (or ml. plasma) × 100]/[cmp/g $P^{32}$ injected]. In animals irradiated with 600 r, BCC fluctuated between 1.11 ± 0.18 and 5.33 ± 1.63; in dogs irradiated with 1000 r between 0.69 ± 0.15 and 3.60 ± 1.45; and in unirradiated dogs between 0.38 ± 0.12 and 0.69 ± 0.02. The BCC in the plasma increased in irradiated animals in comparison with controls. In the interval between 24 and 144 hr after injection of $P^{32}$, BCC diminished in dogs irradiated with 600 r from 6.31 to 4.80; in animals irradiated with 1000 r it increased from 6.53 to 8.24, while in unirradiated dogs it diminished from 5.32 to 3.46. The higher uptake of $P^{32}$ by leukocytes of irradiated dogs is explained by the larger number of hypersegmented polymorphonuclear cells in the blood of the aniams. (H.H.D.)

**17734** STUDY OF THE INCORPORATION OF RADIOACTIVE PHOSPHORUS ($P^{32}$) IN THE ELEMENTS OF BLOOD UNDER THE ACTION OF X RAYS. II. INCORPORATION OF $P^{32}$ IN THE ERYTHROCYTES OF IRRADIATED DOGS. I. Banu, L. Vlad, V. Dragon, and St. Casat (Oncology Inst., Bucharest). Neoplasma, 8: 177-83(1961). (In French)

The phosphorus-32 concentration of circulating erythrocytes was determined in dogs irradiated with 600- or 1000-r doses of x rays. The results were expressed in terms of biologic concentration coefficient (BCC). BCC was lower 72 hr after irradiation than in unirradiated controls, but was higher than in controls 96 and 144 hr after irradiation. Changes of BCC in whole blood parallel those in erythrocytes. The BCC was also increased in various tissues 144 hr after irradiation (liver, spleen, kidney, lung, and muscle). In dogs irradiated with 100 r it was highest in liver and lung, and after 600 r it was highest in spleen. Contrary to earlier studies, the present results do not show that erythrocytes liberate phosphate after irradiation but that $P^{32}$ uptake is diminished 3 days after irradiation and accelerated subsequently. (H.H.D.)

**17735** LIQUID SCINTILLATION COUNTING OF $^{55}Fe$ AND $^{59}Fe$ DOUBLY LABELED SAMPLE AND ITS APPLICATION TO THE STUDIES ON THE GASTROINTESTINAL ABSORPTION OF IRON. Masao Hattori (Tokyo Univ.) and Teruo Nagai. Radioisotopes (Tokyo), 12: 44-54(Feb. 1963). (In Japanese)

A method for the liquid scintillation counting of $Fe^{55}$ and $Fe^{59}$ in a single sample was described. The average counting efficiency was found to be 16.2 and 56.3%, respectively. Iron absorption studies were performed in three human subjects after the ingestion of test iron solution that contained 2.5 mg of elemental iron. Experiments on rabbits and rats were also described. (C.E.S.)

**17736** THE EFFECT OF LIGHT EXPOSURE ON RIBOFLAVIN METABOLISM. E. M. Maslenikova. Vopr. Pitaniya, 21: 56-61(May-June 1962). (In Russian)

Exposure of rats to ultraviolet irradiation resulted in changes in the riboflavin metabolism. With low radiation doses ($2\frac{1}{2}$ erythemic doses) the riboflavin level in the blood rose while its content in the organs remained unchanged. High irradiation doses (9 erythemic doses) produced an opposite effect, the riboflavin content in blood

fell while that of the organs tended to reduce the riboflavin levels in both blood and organs. It appears that exposure to lesser doses of ultraviolet irradiation increased the ability of the tissues to retain riboflavin. A high supply of riboflavin increased the ultraviolet tolerance radiation of the animals. (Aerospace Med., Jan. 1963).

## Fallout and Ecology

*Refer also to abstract 18426.*

**17737** (TID-18389) RADIOELEMENT STUDIES IN THE OCEANS. (Woods Hole Oceanographic Institution, Mass.). [1963]. Includes Appendices: GENERAL SUMMARY OF PROGRESS, 1962-63. FISSION PRODUCT CONCENTRATIONS IN CHUKCHI SEA WATER. V. T. Bowen and T. T. Sugihara. ATLANTIC WEATHER STATION OBSERVATIONS. V. T. Bowen and T. T. Sugihara. VERTICAL DISTRIBUTION OF FALLOUT RADIONUCLIDES IN THE ATLANTIC OCEAN. V. T. Bowen and T. T. Sugihara. LITHIUM IN THE MARINE BIOSPHERE. V. T. Bowen, G. D. Nicholls, and H. Curl, Jr. Contract AT(30-1)-2174. 38p.

Radiation data from samples collected in the Bering Sea–Chukchi Sea area during the period 1959 to 1962 are discussed and compared with data from Arctic Ocean samples. Radionuclides of greatest interest in these samples are $Sr^{90}$, $Ce^{144}$, and $Pm^{147}$. Atlantic Weather Station observations are discussed, and conclusions based on these observations concerning mixing and fallout are presented. In studies of vertical fallout distribution in the Atlantic Ocean, data from large-volume water samples collected during the period 1959 to 1961 are tabulated and analyzed. It is noted that further work is required before the data can be interpreted. In work on Li in the marine biosphere, data on Li–Rb ratios in plankton were collected and are discussed. (J.R.D.)

**17738** (JPRS-18548(Excerpt)) ON THE ACCUMULATION AND EXCRETION OF THE RADIOACTIVE ISOTOPES OF SEVEN CHEMICAL ELEMENTS IN DRAGONFLY LARVAE. G. A. Volkova. Translated from Zool. Zh., 42: 138-9(1963). (OTS-63-21502(Excerpt))

Tests were conducted on the accumulation and excretion of $S^{35}$, $Co^{60}$, $Sr^{90}$, $Ru^{106}$, $Cs^{137}$, $Ce^{144}$, and $Pm^{147}$ in dragonfly larvae. As in other aquatic insects, accumulations of Co and Ce were highest and S lowest. In the cases of S, Cs, Co, and Ru, increases in the accumulation coefficients were observed throughout the entire experiment (8 days). In the cases of Sr, Ce, and Pm, decreases in accumulation coefficients occurred on the 8th day. Sulfur was practically all excreted from the organism. Despite its high accumulation rate, the desorption of Co was very substantial. The other elements were removed in lesser amounts and approximately uniformly. It was found that excretion of the radioisotopes depends on the exposure time of the insect in the radioactive environment. (M.C.G.)

**17739** DEMONSTRATION OF $Mn^{54}$ AND $Co^{57}$ IN PLANTS AS A RESULT OF RUSSIAN NUCLEAR TESTS. F. Scheffer and F. Ludwieg (Universität, Gottingen, Ger.). Atompraxis, 9: 75-7(Mar. 1963). (In German)

In addition to uranium fission products, $Mn^{54}$ and $Co^{57}$ were demonstrated in a grass sample (160 g) by a combination of simple radiochemical separation processes with gamma-spectrometric measurements. These two radionuclides are formed during nuclear tests by high-energy neutron radiation from the bomb. (auth)

**17740** INFLUENCE OF CELL TOXINS ON THE UPTAKE OF $C^{14}$ FROM $NaH^{14}CO_3$ BY ISOLATED BARLEY ROOTS. W. Hoefner (Universität, Giessen, Ger.). Atompraxis, 9: 82-6(Mar. 1963). (In German)

Laboratory tests were made on the influence of various concentrations of 2,4 DNP, $Na_2HAsO_4$, and $NaN_3$ on the uptake of $C^{14}$ from $NaHC^{14}O_3$ by isolated barley roots. Total activity in the roots, the activity of the organic acid fractions, and the activity of three single organic acids served as a criterion of the incorporation of $C^{14}$ in the organic substance. 2,4 DNP at a molar concentration of $10^{-5}$ in the uptake solution showed a negative influence on total uptake and on the incorporation of $C^{14}$ in the fraction of the original acids; at a molar concentration of $10^{-4}$ this influence became even more marked. With the use of $Na_2HAsO_4$ and $NaN_3$ as indicators, this effect first appeared at a molar concentration of $10^{-3}$, and the two low-concentration areas showed practically no effect. In contrast, a stimulation of $C^{14}$ uptake was found with $Na_2HAsO_4$ at a molar concentration of $10^{-5}$. In regard to the three single organic acids, cell toxins were found to produce very clear effects in malic and citric acid, but not in tartaric acid; this indicates the central position of the acids of the Krebs cycle in the binding of $C^{14}$ by the roots. With a decrease in the carbohydrate content of the roots, the uptake of $C^{14}$ from $NaHC^{14}O_3$ also declined. However, six to eight-day-old roots varied but slightly in their carbohydrate content. Lowering the temperature of the uptake solution also produced markedly decreased values for $C^{14}$ uptake; from this it may be concluded that this process, like others previously studied, is energy dependent. (auth)

**17741** STUDIES ON THE ENRICHMENT AND DISTRIBUTION OF RUBIDIUM IN BARLEY SPROUTS. L. E. Lisanti and U. Marckwordt (Landwirtschaftliche Forschungsanstalt Büntehof, Hanover). Atompraxis, 9: 92-5(Mar. 1963). (In German)

A study was made of the enrichment and distribution of Rb in seven-day-old barley sprouts under the influence of the counter-ions Ca, Mg, and $NH_4$, as well as mixtures of these. Ca and Mg favored the enrichment of Rb, and $NH_4$ inhibited it. Distribution of Rb between the shoot and the root was not affected by Ca and Mg. Greater inhibition of enrichment was caused by Rb in the shoot, and by $NH_4$ in the root. In mixture solutions, the effects of the various counter-ions overlapped. Ca was able to compensate for the negative influence of $NH_4$, but not for that of Rb. The results obtained are discussed in relation to the carrier theory of nutritional uptake. (auth)

**17742** A COMPARISON OF THE ABSORPTION AND RETENTION BY RABBITS OF STRONTIUM-90 INCORPORATED INTO PLANT MATERIAL AND OF ADDED STRONTIUM CHLORIDE IN THE DIET. T. E. F. Carr and Julie Wall (Medical Research Council, Harwell, Berks, Eng.). Brit. J. Nutr., 15: 165-8(1961).

Attempts were made to determine whether organic substances in plants would affect Sr incorporation in grass tissues and $SrCl_2$ added to the same diet. Samples of grass hay containing incorporated $Sr^{90}$ were fed to rabbits to check the relative absorption from the diet of the incorporated $Sr^{90}$ and added $Sr^{85}$ from $Sr^{85}Cl_2$. In short-term feeding experiments, rabbits absorbed ~14% of the dose and retained about 4.5% in the tissues 24 hr after administration of both nuclides. In longer experiments, lasting 21 days, ~25% of the dose was absorbed by rabbits. The higher retention was mainly skeletal and was reflected in the smaller percentage excreted in the urine. There was

no significant difference in the behavior of the 2 forms of Sr, and it may be concluded that there is no difference in their absorption or retention. It was also concluded that for rabbits the relative availability of Sr incorporated into grass is the same as for $SrCl_2$ in an identical diet. Hence it appears that the 2 forms of Sr enter a common gut pool and are interchangeable even though the overall uptake of the element may be reduced or increased by changes in the amounts in the diet of phytates or other organic materials found in plants. (TCO)

**17743** RESULTS OF MEASURING OF ATMOSPHERIC FALLOUT IN THE YEARS 1961-1962 AND THE QUESTION OF THE INCREASE IN ITS ACTIVITY IN SPRING. Vilem Santholzer (Charles Univ., Prague). Cesk. Casopis Fys., 13: No. 1, 8-12(1963).

Measurements of monthly fallout in Czechoslovakia in 1961 and 1962 were made with the objective of determining phenomena in various seasons. It was found that an increase in fallout occurred in the September and October period against that in August 1961, which was of the order of tenths mc/km$^2$, and continued to increase in April and May period 1962 when it reached 59.30 mc/km$^2$. It began to decrease in June. Samples of fallout taken during the spring season 1962 did not contain fresh fission products, proving the theory of interdependence between air movement in stratosphere and its penetration into the troposphere in spring to be correct. (OTS)

**17744** RADIOACTIVE FALLOUT. Robert M. Marine (Delaware Hospital, Wilmington). Delaware Med. J., 34: 85-92(Mar. 1962).

Various aspects of fallout are reviewed, both with respect to current levels from weapons tests and to hypothetical conditions following a thermonuclear attack on the United States. (H.H.D.)

**17745** RADIOACTIVE FALLOUT AND THE MILK SUPPLY. J. D. Burton (Agriculture Research Council, Wantage, Berks, Eng.). J. Soc. Dairy Technol., 15: 213-19 (Oct. 1962).

The consequences of atmospheric releases of radioactivity and, in particular, the important nuclides in worldwide fallout and their movement in food chains are discussed. The main deposition of worldwide fallout is in rain, and concentration of radioactivity in rainwater at a given time is fairly constant over a region of moderate size. As a result, it was found that variations in deposition within the United Kingdom are closely related to the average amount of rainfall in different parts of the country. The food chain on land is illustrated, and the difference between short- and long-lived nuclides is discussed. Considerable discussion is devoted to $Sr^{90}$ in the food chain, including presence in soil, uptake by plants, significance in human diet, and presence in milk. The milk sampling program in the United Kingdom since 1958 is explained, and seasonal trends in $Sr^{90}$ content are graphed for 1958 through 1960. It is pointed out that the radiological significance of $Cs^{137}$ in the food chain is considerably less than is that of $Sr^{90}$. Since $I^{131}$ has a short half life, entry into the diet by direct uptake only is considered. It is pointed out that $I^{131}$ can be important only when relatively fresh fission products have been deposited. (P.C.H.)

**17746** INFLUENCE OF THE APPLICATION OF STABLE STRONTIUM TO SOIL ON THE CONTENT OF STRONTIUM IN CULTIVATED VEGETABLES. USE OF ACTIVATION TECHNIQUES AND $\gamma$ SPECTROMETRY. C. Myttenaere and R. Kirchmann (Centre d'Études Nucléaires, Mol, Belg.). Physiol. Plantarum, 15: 656-62 (1962). (BLG-95). (In French)

Determination of the amount of stable strontium in Lolium italicum and Trifolium pratense, grown on poor soil enriched by stable strontium (3 and 7.5 g/m$^2$) is described. In case of Sr-rich specimens, the determinations may be done on basis of the $Sr^{85}$ measurements without thorough chemical separation. For Sr-poor specimens, the described separation technique allows the $Sr^{87m}$ measurement. The adsorption of Sr, sprayed on the soil surface, is a function of the depth of roots. The soil labour during the second season allowed the Trifolium pratense to adsorb more intensively the Sr, added in the first season. The supply of a small quantity of stable Sr modifies the Ca amount of the vegetables. (auth)

**17747** FALLOUT: STATEMENT BY MINISTER OF SCIENCE. Lord Hailsham (Ministry of Science, London). Roy. Soc. Health J., 82: 25-6(Jan.-Feb. 1962).

Health and genetic risks from fallout resulting from nuclear weapons tests are discussed, with particular respect to $I^{131}$ and $Sr^{90}$. The monitoring program for detecting fallout levels in the United Kingdom is described and recent findings are cited, following the Russian tests. It was concluded that present levels, especially of $I^{131}$ and $Sr^{90}$ in milk, do not warrant special measures for removal of radionuclides from food supplies. (H.H.D.)

**17748** HUMAN CONTAMINATION BY FALLOUT RADIOACTIVE IODINE. Semana Med. (Buenos Aires), 118: 343-5(Feb. 16, 1961).

A discussion of the hazards to human populations from radioiodine in food supplies as a result of thermonuclear weapons tests is presented. (H.H.D.)

**17749** SOIL COLLOIDS AS A FACTOR IN THE UPTAKE OF COBALT, CESIUM, AND STRONTIUM BY PLANTS. E. R. Graham and D. D. Killion (Missouri Agriculture Experimental Station, Columbia). Soil Sci. Soc. Am. Proc., 26: 545-7(Nov.-Dec. 1962).

A study of the uptake of Co, Cs, and Sr by rye, garden peas, and soybeans showed that the amount of these elements harvested, as well as the concentration in the plants, varied with the nature of the soil colloid on which they were grown. Illite, kaolinite, montmorillonite, peat (fibrous), peat (sedimentary), and Putnam clay were Ca-saturated, mixed with nutrients and sand; and treated with known amounts of radioactive $Co^{60}$, $Cs^{137}$, and $Sr^{85}$. Cultures of rye, peas, and soybeans were started in sand-nutrient solution mixtures, then transferred to the radioactive colloid-sand-nutrient mixture. After a period of growth, the plants were harvested, weighed and assayed for their content of radioactivity. A study of the adsorption of the nuclides by the colloids was made by the determination of the distribution coefficient of each radioactive nuclide as a trace amount in Ca-saturated exchange systems in 0.01M $CaCl_2$ solution. The order of uptake of Co by the rye plants was highest on illite followed in order by kaolinite, Putnam clay, peat (sedimentary), montmorillonite, and peat (fibrous). The uptake of Cs by the rye plants was highest in the plants grown on (fibrous) peat (10.59% harvested), and lowest for the plants grown on Putnam clay (0.36% harvested). The uptake of Sr by the rye plants was highest for the plants grown on montmorillonite (2.08% harvested). The uptake of the nuclides by peas and soybeans followed closely that of rye. Data obtained from the distribution coefficient studies of the elements for the exchangers after equilibration in 0.01M $CaCl_2$ solution reveal more Co adsorbed by the peats than by the clays; a high adsorption of Cs by illite and Putnam clays; and small differences with Sr with exchangers other than kaolin. The adsorption of the three elements was lower for kaolin than

for the other cation exchangers. The percentage of Co and Cs harvested by the plants was correlated with the reciprocal of the distribution coefficient. (auth)

**17750** TESTING FOOD FOR RADIOACTIVE CONTAMINATION. Mack I. Shanholtz (State Health Commissioner of Virginia, Richmond). Virginia Med. Monthly, 89: 185-6(Mar. 1962).

The establishment of a sampling station in Virginia by the U. S. Public Health Service on January 15, 1962, is discussed, as well as its monitoring program for $Sr^{89}$, $Sr^{90}$, $C^{14}$, $I^{131}$, and $Cs^{137}$ in foods. (H.H.D.)

## Radiation Effects on Living Tissues

*Refer also to abstracts 17651, 18364, 18370, 18371, 18372, and 18373.*

**17751** (AD-283327) A STUDY OF BONE CHANGES IN ALBINO RATS SUBJECTED TO LOW INTENSITY COBALT-60 GAMMA RADIATION. Annual Progress Report No. V, September 1, 1961–August 31, 1962. Pauline Berry Mack, George P. Vose, and Sidney O. Brown (Texas Woman's Univ., Denton. Nelda Childers Stark Lab. for Human Nutrition Research). Aug. 31, 1962. Contract DA 49-007-md-956. 122p.

Young adult male albino rats received 50 r/day of $Co^{60}$ gamma radiation for 91 days with results compared with non-irradiated controls. The latter surpassed the irradiated animals in increase in body weight, skeletal growth, rate of fracture healing, and bone strength. A macrofractionated study was conducted with one group of young adult male albino rats which received 50 r/day of $Co^{60}$ gamma radiation continuously for 77 days; one group with alternating 7-day radiation and rest periods for the same length of time; and one group receiving no radiation. The fractionated radiation produced less deleterious effects on certain aspects of skeletal status than the continuous radiation exposure; and the non-irradiated controls surpassed the two irradiated groups. Quantitative microradiographic techniques were applied to a study of the mechanism of the healing of bone fractures. (auth)

**17752** (AFOSR-2950) THE MECHANISM OF PHOTOPHOSPHORYLATION IN CHLOROPLASTS. Final Technical Report. M. Avron (Weizmann Inst. of Science, Rehovoth, Israel). Apr. 30, 1962. Contract AF61(052)-390. 6p. (AD-283586)

The mechanism of photophosphorylation was investigated by determining the effects and causes of the inactivation of photophosphorylation and the Hill reaction brought about by ultraviolet irradiation of the chloroplasts, a light-dependent adenosine triphosphatase reaction, and a treatment of the chloroplasts which uncouples them in a reversible manner. A component of the chloroplasts was separated which is required for the recoupling procedure. (auth)

**17753** (BNL-6253) EXTRACORPOREAL IRRADIATION OF BLOOD: MATHEMATICAL CONSIDERATIONS OF THE RADIATION DOSE DELIVERED TO A LIQUID BEING PUMPED THROUGH A RADIATION FIELD FROM AND BACK TO A RESERVOIR. Daniel Slatkin, C. R. Jansen, and E. P. Cronkite (Brookhaven National Lab., Upton, N. Y.). [nd]. Contract [AT(30-2)-Gen-16]. 16p.

The radiation dosimetry of circulating blood passing through an extracorporeal radiation field is discussed. A schematic diagram and photographs of the experimental set up are presented. The flow rate through the shunt is 300 ml/min, the dose rate is approximately 300 r/min, and the transit time through the irradiation field is about 3 min. A procedure is described for the mathematical analysis of the radiation dose received. (C.H.)

**17754** (BNL-6274) PROTEIN SYNTHESIS IN THE IRRADIATED INTESTINE OF THE MOUSE. Martin Lipkin, Henry Quastler, and Frank Muggia (Cornell Univ., Ithaca, N. Y. Medical Coll. and Brookhaven National Lab., Upton, N. Y.). [1962]. Contract AT(30-1)-2179. 21p.

Protein synthesis in the irradiated intestine of the mouse was studied. $C^{14}$ labeled leucine was used for radiochemical investigations and $H^3$ leucine for autoradiographic studies. No reduction in tracer uptake was found during the first day after irradiation, with doses up to 2500 rad, in any of the cells and cell components studied. (auth)

**17755** (BNL-6276) THE EFFECT OF A DEUTERON MACROBEAM ON GREYING OF HAIR. Howard J. Curtis (Brookhaven National Lab., Upton, N. Y.). [1962]. Contract [AT(30-2)-Gen-16]. 13p.

Black mice were exposed to a deuteron macrobeam to assess the greying response from heavy primary cosmic ray particles. It was found that greying depends solely on a direct hit by the radiation on the bulb of the follicle. It was concluded that the heavy primary cosmic ray particles would be expected to cause greying of the hair. The result strengthens earlier conclusions indicating that these particles will cause very minor somatic damage in mammals. (auth)

**17756** (HW-55856) OPERATION AND MAINTENANCE MANUAL FOR THE DOG COUNTER. W. G. Spear and M. O. Rankin (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). June 1, 1958. Contract AT(45-1)-1350. 31p.

A five-detector steel-shielded dog counter system was designed for the monitoring in vivo in animals for $Pu^{239}$, $Sr^{90}$, $Ru^{103}$, $Ru^{106}$, and $Cs^{137}$. Two oppositely-mounted R.C.A. 6655 phototubes and 1.0 mm NaI crystals, each in a movable lead shield within the steel shield, provide detection for $Pu^{239}$ and $Sr^{90}$. Minimum detectable amounts of $Pu^{239}$ and $Sr^{90}$, in vivo, are 1.0 $\mu$c and 0.8 $\mu$c respectively. Three phototubes, R.C.A. 6655, mounted 120° apart in a vertical plane and incorporating 2-inch × 2-inch NaI crystals are used for $Ru^{103}$, $Ru^{106}$, and $Cs^{137}$ detection. These probes are also lead-shielded and movable within the steel shield to provide a variable-size opening as required by different animals. The minimum detectable amounts of the particular radioisotopes in vivo are as follows: $Cs^{137}$, 0.1 $\mu$c; $Ru^{103}$, 0.1 $\mu$c, and $Ru^{106}$, 0.2 $\mu$c. The figures stated for all radioisotopes are conservative and improvement factors of two to one may be expected with judicious use of the system, and depending upon the particular animal-type or circumstances involved. (auth)

**17757** (TID-16572) A COMPARISON OF RADIATION-INDUCED GRANULOCYTOPENIA IN SEVERAL MAMMALIAN SPECIES. Harvey M. Patt and Mary A. Maloney (Argonne National Lab., Ill.). June 1962. Contract [W-31-109-Eng-38]. 11p. (UAC-6501)

Comparison of the early granulocytopenia in several mammalian species after comparable irradiation reveals a similar rate of decline, which approximates the normal rate of disappearance from circulation. The time between irradiation and onset of granulocytopenia varies and may perhaps be related to species differences in the nonmitotic differentiating marrow pool. (auth)

**17758** (TID-16650) VARIATION OF RADIOSENSITIVITY TO DAILY NEUTRON EXPOSURES IN MOUSE STRAINS SELECTED FOR SURVIVAL UNDER X-IRRADIATION.

Howard H. Vogel, Jr., Donn L. Jordan, and Thomas H. Roderick (Argonne National Lab., Ill. and Roscoe B. Jackson Memorial Lab., Bar Harbor, Me.). June 1962. Contract W-31-109-eng-38. 11p. (UAC-6582)

Two lines of mice, showing significant differences in response to daily exposures to 100 r x rays, were exposed to brief daily irradiation with 42 ± 4 rads of fission neutrons. Mice of the sixth selected generation were irradiated seven times a week with fission neutrons at Argonne National Laboratory's CP-5 Research Reactor. The mean survival time of the low-resistant line was 21.8 days and that of the high-line was 26.8 days. The two selected lines showed similar differences in survival under daily doses of 100 r x rays and under daily doses of 42 rads fission neutrons. The assumed value for RBL (2.5) appeared to be approximately correct. No significant differences in survival times could be established between males and females in the neutron-irradiated mice. Male mice, of both lines, showed a positive correlation between pre-irradiation body weight and survival time. (auth)

**17759** (TID-18218) PROGRESSIVE DETERIORATION OF MUSCLE FINE STRUCTURE IN RINGER SOLUTION. Adolfo Portela, Juan C. Perez, Peter Stewart, Howard Jenerick, and Marion Hines (Emory Univ., Atlanta). [1961]. Contracts AT(40-1)-2700 and DA-49-193-MD-2256. 19p.

Frog sartorius muscles were washed in standard Ringer solution for periods from one to eight hours after dissection, fixed in osmic acid, and sectioned longitudinally for electron microscope examination. Increasing deterioration with time of soaking was observed in the morphology of the sarcolemma (plasma membrane, basement membrane, and extracellular fibrous network), the myofilaments, and the mitochondria, but little or no change in the sarcoplasmic reticulum. In spite of extensive structural degradation after 8 hours soaking, muscles remained excitable and contractile. (auth)

**17760** (TID-18219) ION EFFECTS IN X-RAY DEPOLARIZATION OF MUSCLE MEMBRANE. Adolfo Portela, Juan C. Perez, Peter Stewart, and Marion Hines (Emory Univ., Atlanta). [1961]. Contract AT(40-1)-2700 and DA-49-193-MD-2256. 20p.

Irradiation of frog sartorius muscles with 100 Kr of x rays results in a relative decrease in resting membrane potential which is dependent on external sodium concentration, but not on potassium concentration provided that the latter exceeds 1.0 mM. In zero potassium solutions, the potential decreases more, and continues to fall after irradiation. Neither irradiation nor stimulation alters the rate at which $Ca^{45}$ is lost from previously loaded muscle fibers. These results are interpreted to mean that irradiation damage to the muscle cell membrane results in increased permeability to sodium, but not via the release of calcium ions. The sodium extrusion mechanisms are altered by irradiation so as to require an external potassium concentration above 1.0 mM to match the increase of Na influx. Permeability to potassium does not appear to be altered by irradiation. (auth)

**17761** (TID-18220) IRRADIATION AND CESIUM DEPOLARIZATION OF MUSCLE MEMBRANE. Adolfo Portela, Juan C. Perez, Peter Stewart, and Marion Hines (Emory Univ., Atlanta). [nd]. Contracts AT(40-1)-2700 and DA-49-193-MD-2256. 14p.

Cesium ions in the bathing fluid produce a depolarization of frog sartorius muscle fibers independent of the depolarization produced by irradiation. The fractional depolarization produced by x rays is independent of external cesium concentration. However, the fractional depolarization is proportional to external sodium concentration and is therefore explained as the result of an increased sodium ion permeability. Cesium depolarization in non-irradiated fibers increases with decreasing sodium concentration, with osmolarity maintained by choline chloride, indicating the possibility of a sodium-choline-cesium interaction in the membrane. A simple concentration-cell potential explanation for the cesium effects is not yet adequate. (auth)

**17762** (TID-18222) RADIATION AS AN UNCOUPLING AGENT IN FROG MUSCLE. A. Portela, J. C. Perez, P. Stewart, L. Nelson, and M. Hines (Emory Univ., Atlanta). [1961]. Contracts AT(40-1)-2700 and DA-49-193-MD-2256. 15p.

X ray exposure of 100,000 r in vitro increases the rate of oxygen consumption of frog sartorius muscles in Ringer solution from 3.3 to 7.1 micromoles oxygen per gram muscle per hour. Addition of iodoacetic acid after irradiation eliminates this increase. Addition of maximally uncoupling concentrations of dinitrophenol after irradiation also eliminates any radiation effect on $O_2$ uptake. Addition of partially uncoupling concentrations of DNP after irradiation results in additive effects of radiation and DNP on $O_2$ uptake. These results can be explained by the hypothesis that this dose of radiation increases oxygen uptake by partially uncoupling oxidation from phosphorylation, without significantly damaging other parts of the oxidative chain. (auth)

**17763** (TID-18260) DEVELOPMENT OF SMALL IN VIVO $\beta$-RAY DETECTORS AND THEIR DIAGNOSTIC APPLICATIONS. I. SUMMARY OF DEVELOPMENT WORK TO DATE. Final Report. II. EVALUATION PROGRAM AT NEUROSURGICAL CENTERS OF BRAIN TUMOR LOCALIZATION UNITS USED AT OPERATION WITH $P^{32}$. Progress Report. Charles V. Robinson (New England Center Hospital, Boston). Feb. 28, 1963. Contract AT(30-1)-1726. 41p.

A short, 2-mm-diameter, tip-sensitive proportional counter was developed for diagnostic use. Design features and modifications are described. Applications of the counter in the localization of brain tumors and eye lesions after the administration of $Hg^{203}$, $Ga^{68}$, $P^{32}$, or $Kr^{85}$ are reported. A series of dog experiments was carried out in an investigation of diagnostic procedures, using $Kr^{85}$, for the detection of cardiac shunts in infants and children. The experiments with dogs showed the method is not feasible for use in children. Subsequent analysis of the detector requirements and corollary experiments indicated that either a solid-state detector or an aluminum-walled proportional counter would give better results. (C.H.)

**17764** (TID-18338) PHYSIOLOGICAL STUDIES ON CONGENITAL DEFORMITY IN MICE. MECHANISM OF ACTION OF RADIATION AND RADIOMIMETIC TREATMENTS. Final Report, December 1, 1954–November 30, 1962. Charles P. Dagg and Meredith N. Runner (Roscoe B. Jackson Memorial Lab., Bar Harbor, Me.). Apr. 1, 1963. Contract AT(30-1)-1762. 9p.

The effects of fluorouracil and fluorodesoxyuridine, singly and in combination with uracil and thymidine, on the induction of congenital deformaties in mice were studied. Results indicate that embryocidal and teratogenic effects are dependent upon the strain of mice, age of embryos, and the dosage. The inheritance of high and low frequencies of deformities induced by fluorouracil was investigated in crosses between two strains of mice. The embryocidal and teratogenic effects of x irradiation were studied in three strains of mice and in hybrids from two of these. Homozygous embryos from two strains showed sim-

ilar rates of mortality while those of the third strain were more resistant. Hybrid embryos from the two susceptible strains were more resistant to the lethal effects of radiation than either of the parental strains. Malformation of the tail occurred with similar frequencies in all three types of homozygous embryos. A strain with a low incidence of spontaneous polydactyly responded with the highest frequencies of malformed hind feet. An increased incidence of polydactyly was observed after exposure to 75 r at 10 days post coitum. It was demonstrated that withholding food from gravid females for 24 hours during the 8th to the 11th days post coitum would cause defects in the fetal axial skeleton. The frequency of deformity was dependent upon the strain of mice, the age of the pregnant female, and the day of pregnancy. The interaction of fasting with other teratogenic treatments was investigated. Preliminary results are included. (C.H.)

**17765** (TID-18414) THE RELATIONSHIP BETWEEN SOMATIC AND GENETIC RESPONSE OF TOMATO SEED AND POLLEN TO X-IRRADIATION USING "WATER PROTECTION" AND MUTATIONS AT SPECIFIC LOCI. Final Report. Allan B. Burdick (Purdue Research Foundation, Lafayette, Ind.). Mar. 15, 1963. Contract AT(11-1)-856. 10p.

Results are reported from studies on somatic and genetic effects of x radiation on tomato seed and pollen. The presence of some mechanism that affords protection or acts as a buffer against genetic injury was suggested when seeds were irradiated under partially hydrated conditions. The characteristics of radioinduced mutations are discussed. Data are included on the frequency and biochemical characteristics of mutations resulting from the irradiation of hydrated pollen. (C.H.)

**17766** (UR-623) THE EFFECT OF ORALLY ADMINISTERED EPSILON AMINOCAPROIC ACID ON THE DEPOSITION AND/OR RETENTION OF RADIOIODINATED FIBRINOGEN AND ANTIBODIES TO FIBRINOGEN IN SUBCUTANEOUS RAT PLASMA CLOTS AND TURPENTINE-INDUCED ABSCESSES OF THE RAT. Letitia Eleanor Mutschler (Rochester, UN. Y. Univ. Atomic Energy Project) Jan. 25, 1963. Contract W-7401-eng-49. 117p.

Treatment of metastatic cancer through the use of highly radioactive labeled tumor-localizing antibodies would have the advantage over conventional radiation therapy techniques of delivering large doses of radiation to areas of malignancy while at the same time sparing vital normal tissue from excessive radiation. Intravenously administered $I^{131}$-labeled rat fibrinogen and antibodies to rat fibrin or fibrinogen were found to localize with considerable specificity in the rat-carried Murphy-Sturm lymphosarcoma. It was suggested that fibrin deposition in tumors is a phenomenon associated with the growth of these tumors and may be of significance in rapidly growing tumors. An apparent lack of $I^{131}$-fibrinogen localization was observed in some transplantable rat tumors, such as the Walker carcinoma 256. The hypothesis that fibrin deposition is masked by its subsequent rapid removal by fibrinolytic processes was investigated. Data are presented from an investigation of the in vivo antifibrinolytic properties of epsilon aminocapronic acid (EACA), a potent in vitro fibrinolytic inhibitor. Two basic test systems, both using the rat as an experimental animal, were employed. The first involved measuring the effect of orally administered EACA on the retention of subcutaneous clots labeled with either $I^{131}$-fibrinogen or $I^{131}$-antibody against rat fibrinogen. The second system involved measuring the effect of EACA treatment on the deposition and retention of intravenously injected $I^{131}$-fibrinogen and $I^{131}$-antibody in subcutaneous turpentine-induced abscesses. Data indicate that EACA is a potent in vivo anti-fibrinolytic agent and that the mechanism by which EACA treatment brings about increased tumor localization of $I^{131}$-fibrinogen and $I^{131}$-antibody is the inhibition of their subsequent removal by fibrinolytic processes. (C.H.)

**17767** (USNRDL-TR-616) COMPARATIVE EFFECTS OF 50 KVP AND 250 KVP X RAYS ON THE DOG. S. J. Baum and E. L. Alpen (Naval Radiological Defense Lab., San Francisco). Jan. 24, 1963. 21p.

The subject of relative biological effectiveness of various ionizing radiations has been difficult and vexing to handle meaningfully when tissue distribution of dose is not uniform. It has been suggested by some that problems relating to linear energy transfer in tissues should appropriately be divided into two components, that relating to macroscopic energy distribution and that relating to energy distribution in terms of individual ionizing events. The former effect was evaluated by looking at the biological potency of a lower energy x-ray source (50 Kvp) in the dog. Previously it was shown that no single dose parameter is adequate to express the biological potency of lower energy x rays, although it was suggested that, to the extent that it was possible to measure it, the dose to the critical organ, usually bone marrow, would be the most significant. Further studies were completed on dogs exposed to high doses of x radiation from a 50 Kvp beryllium window generator. Doses of 4000 to 10,000 rad (air) at the potential midline of the subject were shown to be as effective as doses of 200 to 300 rad of 250 Kvp x rays. Hematological comparisons of the two radiations show close correlation with mortality and a relative potency factor of $\frac{1}{20}$ for the lower energy radiation. The lethal dose of 50 Kvp x rays for the dog is 7500 r (air). Serious lesions of the skin were seen as a complicating factor at all doses in excess of 4000 r (air). Dosimetry was done in tissue equivalent wax phantoms using the rotational exposure method. Phantom depth dose measurements with miniature ion chambers and chemical dosimetry in agar gels yielded essentially identical values of 3% for midline tissue dose. (auth)

**17768** (CEA-tr-R-1632) DIMINUTION DE L'EFFET NUISIBLE DES RAYONS GAMMA DU $^{60}Co$ SOUS L'INFLUENCE DE L'ACIDE GIBBERELLIQUE ET DES SELS POTASSIQUES. (Diminution of the Harmful Effects of $Co^{60}$ Gamma Radiation Under the Influence of Gibberellic Acid and Potassium Salts). M. M. Tushnyakova (Touchniakova). Translated into French from Tr. Inst. Genet., Akad. Nauk SSSR, 28: 158-62(1961). 15p.

High gamma doses (15,000 to 30,000 r) act on oat seeds in the dormant state to cause death of the seeds during the germination period. The destruction percentage increases with increased radiation doses. Moreover, the surviving plants are retarded in vegetation and growth, and their productivity can be reduced to the point where sterility is complete. The treatment of oat seeds by solutions of gibberellic acid and of potassium chloride and potassium phosphate results in a strong reduction of the harmful effects of gamma irradiation. (tr-auth)

**17769** (JPRS-18395) PROBLEMS OF SPACE BIOLOGY, VOLUME II, 1962. N. M. Sisakyan and V. I. Yazdovskii (Yazdovskiy), eds. Translation of "Problemy Kosmicheskoi Biologii," Vol. II, Moscow, 1962. 438p. (OTS-63-21437)

A complete translation is presented of the Russian-language book Problems in Space Biology. The book

contains papers on general problems of space biology and medicine; results of experimental studies on spaceships, high-altitude rockets, and air craft; and results of laboratory studies with simulation of the effects of space flight conditions on the bodies of man and animals. Separate abstracts were prepared on 14 papers covering the biological effects of space radiations. (C.H.)

**17770** (JPRS-18395(p.9-25)) PROBLEMS OF RADIATION SAFETY OF SPACE FLIGHTS. A. V. Lebedinskii (Lebedinskiy) and Yu. G. Nefedov. (Translation)

Problems of human space flight are reviewed. It is pointed out that biological phenomena occurring in space are influenced by the simultaneous effects of weightlessness, linear accelerations, excess vibration, prolonged isolation, and space radiations. Space radiations should be considered among the extreme factors since irradiation of man during flight can cause severe sickness and even death if special protective measures are not taken. During flight into space man may be exposed to primary cosmic radiation, radiation of the radiation belt of the earth and other planets, radiation of sunspots, and radioactive gases and aerosols. The relative biological effectiveness of each radiation type is considered. Radiation hazards when the energy requirements of the spaceship are provided by a nuclear-powered unit are also discussed. Prophylactic and therapeutic agents and their effectiveness in the prevention and treatment of radiation injuries incurred under space flight conditions are evaluated. (C.H.)

**17771** (JPRS-18395(p.104-22)) THE EFFECT OF SPACE FLIGHT FACTORS ON SOME BIOLOGICAL INDICES IN INSECTS. Ya. L. Glembotskii (Glembotskiy) and G. P. Parfenov. (Translation)

Experiments on the effects of space flight conditions on heredity in Drosophila melanogaster were performed during the flights of 5 Russian satellites. Known differences between space flight conditions of the satellites are reported. Four standard genetic tests were used to determine the rate of primary nondisjunction of chromosomes, induced crossing-over in males, dominant lethal mutations, and sex-linked recessive lethal mutations. A broad spectrum of mutations resulted from space flight conditions. Hereditary changes were obtained associated with nondisjunction of chromosomes at the stage of meiosis, with chromosomal arrangements, and with point mutations. A statistically significant increase in mutation rate was observed in 13 of the 34 variants of the experiments performed. The largest number of point mutations was obtained in one of the longer flights. The point mutations were typical of the effect of small doses of ionizing radiation. A greater mutability of spermatids than sperm cells was demonstrated. Analysis of the results indicates that vibration of the rocket caused by acceleration and weightlessness, as well as cosmic radiation, may be mutagenic space flight factors. Mutations in Drosophila associated with chromosomal aberrations were apparently conditioned to a considerable degree by rocket vibration. Results of experiments on the ground are compared with the space flight data. Experiments performed on a shake-table showed that high-frequency vibration did not induce crossing over but low-frequency vibration produced a mutagenic effect. A number of new tests are suggested for use in studies of the mutagenic effects of various space flight factors. (C.H.)

**17772** (JPRS-18395(p.123-35)) CYTOLOGICAL AND HISTOLOGICAL CHANGES IN THE HEMATOPOIETIC ORGANS OF MICE UNDER THE INFLUENCE OF SPACE FLIGHT ON SPACESHIPS. M. A. Arsen'eva (Arsen'yeva), V. V. Antipov, V. G. Petrukhin, T. S. L'vova, N. N. Orlova, S. Il'ina, L. A. Kabanova, and E. S. Kalyaeva (Kalyayeva). (Translation)

The influence of space flight factors, and primarily of cosmic radiation, vibration, acceleration, and weightlessness on hematopoietic organs of mice was studied in animals from three space flights. The animals were sacrificed at definite periods from 2 to 60 days after the ship landed. Cytological examinations were made of bone marrow and spleen preparations and standard morphological and histological studies were made on all organs. An increase in the frequency of abnormal mitosis and certain characteristic features of chromosomal aberrations, when compared with aberrations occurring after exposure to x rays or neutrons, were noted. The most distinctive feature was the clumping or agglutination of chromosomes. Since the total dose of cosmic radiation recorded by physical instruments on the second flight was slight, it was concluded that the changes observed were induced by vibration, acceleration, or weightlessness. The effects of each of these factors were investigated by appropriate experiments on mice. A cytological analysis of bone marrow cells from experiments on vibration and weightlessness revealed a marked increase in abnormalities in mitosis with chromosomes sticking together at the stage of anaphase. In experiments with acceleration the percentage of sticking did not exceed the control level. The frequency of chromosomal aberrations in the experiments with vibration was close to the level observed on one satellite flight. Serotonin was shown to have a protective effect against vibration injury to the nucleus of cells. Experiments with accelerations in a state of weightlessness showed that possibly a disorder was induced in the spindle apparatus of the cell. It was concluded that the effects of space flight on hematopoietic cells are complicated. (C.H.)

**17773** (JPRS-18395(p.136-47)) PATHOLOGICAL CHANGES IN THE INTERNAL ORGANS OF ANIMALS UNDER THE INFLUENCE OF FLIGHT ON SPACESHIPS. V. G. Petrukhin. (Translation)

The effects of space flight conditions, such as acceleration, vibration, weightlessness, and cosmic radiation were studied in 68 mice and 4 guinea pigs that made flights on the second, fourth, and fifth Russian satellites. All the animals returned alive from the space flights. After the flight, the animals and controls were sacrificed at intervals of 2 to 60 days. Results are summarized from macroscopic and microscopic studies. Data show that under the influence of the combined flight factors some degenerative changes occurred in the organs of the animals. These changes were largely reversible. The organs showing most pronounced changes included the brain, liver, myocardium, spleen, and suprarenal glands. A general adaptation or stress syndrome resulted in marked congestion, hemorrhages of the suprarenal gland, and loss of lipids. Changes from marked circulatory disorders were observed in the entire body, and particularly in those cases where they were associated with a displacement of the main masses of blood to one half of the trunk. Changes in the brain, liver, and myocardium were most like those observed from hemodynamic disorders in the entire body brought about by tissue hypoxia. (C.H.)

**17774** (JPRS-18395(p.148-55)) MICROBIOLOGICAL AND CYTOLOGICAL STUDIES ON SPACESHIPS. N. N. Zhukov-Verezhnikov, I. N. Maiskii (Mayskiy), V. I. Yazdovskii (Yazdovskiy), A. P. Pekhov, A. A. Gyurdzhian, N. I. Rybakov, and V. V. Antipov. (Translation)

A biological system was devised that can transmit in-

formation concerning the viability of biological cells from a satellite to the earth. A special mechanism, operating from a programmer on board the satellite or in accordance with signals from the earth, transfers bacterial cultures to new medium. Cultures of anaerobic, spare-forming bacteria, lysogenic bacteria, HeLa cancer cells, fibroblasts, and amniotic cells were maintained on early satellites and information obtained was used in preparation for manned flights. Microbiological and cytological specimens were also exposed in the cabins of ships during manned flights. The utilization of microbiological and cytological methods for characterizing the biological effects of space flight factors is discussed. (C.H.)

**17775** (JPRS-18395(p.161-72)) THE EFFECT OF SPACE FLIGHT CONDITIONS ON THE SEEDS OF HIGHER PLANTS AND ACTINOMYCETES. V. V. Khvostova, A. A. Prokov'eva-Bel'govskaya (Prokov'yeva Bel'govskaya), B. N. Sidorov, and N. N. Sokolov. (Translation)

A study was made of the effect of space flight conditions on the seeds of certain higher plants and actinomycete spores. The genetic effect was judged by the number of cells showing chromosomal rearrangements in the radicles of the sprouts from pea, onion, and wheat seeds carried on satellite flights. An analysis of the data shows a statistically significant increase in the percentage of cells with chromosomal rearrangements. The most distinct genetic effect was found in wheat. Observations are described in detail. (C.H.)

**17776** (JPRS-18395(p.173-8)) THE PROBLEM OF THE EXPERIMENTAL STUDY OF THE EFFECT OF SPACE RADIATION CONDITIONS ON HIGHER PLANTS. Yu. L. Sokolov and A. V. Gurskii (Gurskiy). (Translation)

Results are reviewed from studies on the effects of simulated space radiation conditions on the growth of higher plants. Data obtained from measurements made on the surface of the earth and by means of rockets were used to estimate the intensity of solar radiation in the ultraviolet region outside the atmosphere. Studies were made at the Pamir Botanical Garden and at locations in eastern Pomir where altitudes vary from sea level to 5000 meters. Gas discharge lamps were used to simulate space radiation conditions within a broad region ranging from 230 to 1000 mμ. It is pointed out that radiation conditions in space are characterized primarily by the presence of shortwave radiation within the range from about 230 to 295 mμ and that this radiation is completely absent from the sunlight that reaches the surface of the earth, even at altitudes of 5000 meters. Plants exposed to the effects of 240 to 270 mμ radiation died as a result of denaturation of cell proteins. Plants exposed during the entire vegetative period for 10 to 12 hr/day to the entire spectrum of solar radiation lived. It is postulated that injury to plant cells and genetic effects produced by ultraviolet light are produced by independent processes. (C.H.)

**17777** (JPRS-18395(p.179-202)) IONIZING RADIATION AT ALTITUDES OF 180-340 KILOMETERS AND RADIOLOGICAL SAFETY DURING FLIGHTS OF SPACESHIPS. V. E. (Ye.) Nesterov, N. F. Pisarenko, I. A. Savenko, and P. I. Shavrin. (Translation)

Data are presented that were obtained from measurements on the second and third Soviet spaceship. The outer radiation belt of the earth was found at altitudes of 180 to 320 kilometers and its limits were established at all longitudes. The relation between radiation intensity and longitude was determined for the upper radiation belt. A marked increase in intensity was found in the South Atlantic and other regions. A drop in radiation intensity was found in the lower radiation belt to altitudes of 230 to 320 kilometers in the area of the Brazilian magnetic anomaly. The distribution of cosmic radiation around the earth was measured and the geographic distribution and magnitudes of the absorbed radiation doses were found. The response of the radiation detectors used is described. Data are presented graphically and the findings are discussed. Problems of radiological safety during space flights are reviewed. (C.H.)

**17778** (JPRS-18395(p.311-20)) SOME DATA ON THE ROLE OF THE TIME FACTOR IN THE RADIATION REACTIONS OF THE CENTRAL NERVOUS SYSTEM. N. N. Livshits, E. (Ye.) S. Meizerov (Meyzerov), Z. I. Apansenko, and M. A. Kuznetsova. (Translation)

The effects of acute, chronic, and fractionated radiations with the same total doses delivered under identical irradiation conditions on the reactions of the central nervous system were studied in rats and rabbits. Indices of nervous system reactions used included the latent period of the unconditioned defense flexion reflex of the rabbit leg, the electrical resistance of the rat cerebral cortex, and the conditioned reflex activity of rats. Whole-body fractionated x rays of 10 r delivered 5 times a week until a total dose of 400 r was reached had the same effect as a single acute exposure on the latent period of the unconditioned defense flexion reflex of the rabbit leg. Whole-body long-term γ irradiation at a dose rate of 6 r/day with a total dose of 160 r and acute irradiation with the same total dose at a dose rate of 85 r/min exerted similar effects on the conditioned reflex activity of rats. Whole-body single γ irradiation with a dose of 600 r and a dose rate of 0.5 r/min produced more marked effects on the electrical resistance of brain tissues than did irradiation with dose rates of 600 r/min. In all cases the leukocyte reactions were more severe after brief exposure than after chronic exposure to the same dose. Functional disorders of the central nervous system were more evident after chronic exposure than after acute exposure to the same dose. Implications of the findings in space flights are discussed briefly. (C.H.)

**17779** (JPRS-18395(p.363-8)) SOME DATA ON THE BIOLOGICAL EFFECTIVENESS OF PROTONS WITH ENERGIES OF 660 Mev. E. B. Kurlyandskaya. (Translation).

The relative biological effects (RBE) of 660-Mev protons and x radiation were compared in mice and rats. The animals were irradiated in a direct collimated beam of protons 10 cm in diameter directly at the outlet of the collimator. The protons were obtained from a synchrocyclotron. Carbon plates were exposed with each group of animals and the dose absorbed by the animals was determined in rads from the flux density of the carbon measured directly after irradiation. The relation between survival and dose was determined and compared with data on x radiation. The $LD_{50/30}$ for mice exposed to x rays was about 500 rads and for protons 1050 rads. The minimum absolutely lethal dose was 600 and 1300 rads, respectively. For rats the minimum lethal dose of protons was about 1500 rads. On the basis of the results it was concluded that the RBE of protons at 660-Mev amounts to 0.5 to 0.6 for mice and 0.6 to 0.7 for rats, taking the effects of x rays as unity. This value of the RBE was also demonstrated by the symptoms of radiation sickness, changes in the blood picture, changes in the gonads, and tumor induction in the animals. (C.H.)

**17780** (JPRS-18395(p.369-79)) THE MUTATIONAL ACTIVITY OF ANTI-PARTICLES. I. A. Rapoport and A. V. Miller. (Translation).

The genetic effects of positrons emitted by $Cu^{62}$ and $Cu^{64}$ were studied in Drosophila melanogaster. The $Cu^{62}$ was obtained by irradiation of $Cu^{63}$ with neutrons by the reaction $Cu^{63}(n,2n)Cu^{62}$, in which case 93% of the $Cu^{62}$ radiation is from positrons and 7% from $\gamma$ radiation with an energy of 1 Mev of which 2.2% comes from annihilation. The source of the positrons from $Cu^{64}$ was Cu foil, with 31.3% positrons, 56% electrons, and 12.7% $\gamma$ radiation. The positrons emitted by $Cu^{62}$ caused recessive lethal mutations, fragmentation of the sex chromosomes, and nondisjunction of microchromosomes at a rate approximately equal to that produced by the action of electrons and x rays of the same dose. Positrons emitted by $Cu^{64}$ acting in combination with electrons caused recessive lethal mutations in the progeny and sterility in irradiated insects corresponding quantitatively to those produced by similar absorbed doses of electrons and x rays. No specific genetic effect characteristic of positrons was demonstrated. (C.H.)

**17781** (JPRS-18395(p.380-96)) THE EFFECT OF HIGH ENERGY PROTONS ON THE RATE OF OCCURRENCE OF MUTATIONS. I. A. Rapoport, S. P. Yarmonenko, and G. A. Avrunina. (Translation).

Male Drosophila were exposed to a collimated beam of 660-Mev protons at doses ranging from about 510 to 12,140 rads. An increase in the rate of recessive lethal mutations in the sex chromosome was noted in proportion to about 2% for every 1000 rads. The results were very similar to those obtained with x and $\gamma$ rays on the same models with the same doses. (C.H.)

**17782** (JPRS-18395(p.397-400)) THE ACTION OF RADIOPROTECTIVE PREPARATIONS AGAINST WHOLE BODY IRRADIATION WITH HIGH ENERGY PROTONS. S. P. Yarmonenko, G. A. Avrunina, V. S. Shashkov, and R. D. Govorun. (Translation).

The relation between chemical protection against radiation injuries afforded by various compounds and ionization density was studied in rats exposed to a 660-Mev proton beam soon after the injection of the protective compound. The compounds used included cysteamine, serotonin, hydroxylamine, and $\beta$-aminoethylisothiuronium (AET) alone and in various combinations. Results are presented in tabular form. All the preparations increased the radioresistance of the animals, and AET was the most effective. Hydroxylamine contributed to an increase in the activity of cysteamine only. Indirect proof was obtained of an oxygen effect in the biological response to accelerated protons. Possible reaction mechanisms involved are discussed. (C.H.)

**17783** (JPRS-18479) CYTOCHEMISTRY OF BLOOD GLYCOGEN IN MAMMALS AFTER SINGLE WHOLE-BODY X-IRRADIATION. A. L. Shabadash and Yu. B. Kheyfets. Translated from Arkh. Anat., Gistol. i Embriol., 43: 29-35(Dec. 1962). 19p. (OTS-63-21470)

Single whose-body x irradiation of rats with 800 r results after 10 to 30 minutes in a loss of glycogen by the neutrophils and thrombocytes. The decrease in glycogen content is at a maximum 1 to 3 hours after exposure against a background of marked leukocytosis and neutrophilosis. Unlike temporary variations in the normal polysaccharide level, disintegration once begun is uncontrollable. Disintegration of the polysaccharide progresses from the central, circumnuclear zones to the periphery of the cells. It results in swelling of the cytoplasm, evidence of the accumulation of the acid products of glycogenolysis. Neutrophil swelling is complicated by the formation of a distinct ectoplasmic membrane and it predetermines the disintegration of the nuclei and cells. Six hours after irradiation the peripheral blood is found to contain many destroyed neutrophils with only traces of glycogen. After 24 hours there is a pronounced leukopenia, despite the development of new generations of cells with moderately high glycogen content approximating the normal. Cytochemical impairment of glycogen metabolism caused by irradiation precedes morphologically apparent injury to neutrophil nuclei and cytoplasm. (auth)

**17784** THE EFFECTS OF ANESTHESIA ON IRRADIATED ANIMALS. S. A. Allan Carson, Torrence M. Young, Joseph S. Mezistrano, and Lucien E. Morris. Acta Anaesthesiol. Scand., Suppl., 6: 71-2(1960). (In English)

For possible use in cases involving accidental exposure to ionizing radiation or in wartime atomic disaster, optimal conditions for anesthesia in the irradiated organism were investigated in animals. Mice and rats were irradiated and anesthetised to a level of anesthesia at which the animals had just become unresponsive to stimulation, simulating the light surgical anesthesia now used commonly in clinical practice. It was believed that this biological endpoint is more valid than any constant dose level. In mice irradiated and then immediately anesthetised with chloroform, diethyl ether, halothane, or Fluoromar (trifluoroethyl vinyl ether), anesthesia increased the incidence of mortality in the irradiated animals over that occurring in the unanesthetised, irradiated controls in all cases. Chloroform had the most adverse effect, followed by diethyl ether and Fluoromar, while halothane was found to have little effect. Further investigations on halothane showed that the anesthetic had no obvious effect on either mortality or weight changes in mice or rats. (TCO)

**17785** STUDIES ON RECOVERY FROM RADIATION INJURY. II. OBSERVATIONS ON THE EFFECTS OF IMPLANTATION OF THE SHIELDED SPLEEN. Yasuro Kamochi, Bunro Watanabe, Noboru Ozono, and Masanobu Tomonaga (Hiroshima Univ.). Acta Med. Nagasakiensia, 6: 1-4(Sept. 1961).

CF1 mice were exposed to a single dose of 930 r whole-body x irradiation with lead shielding of their surgically exteriorized spleens. The mice were sacrificed at various intervals after the irradiation and their spleens were sliced prior to implantation in mice of the same strain. The recipient mice, which were used for the evaluation of the effectiveness of the spleen implants, were exposed to 930 r whole-body irradiation without shielding of their spleens. The radiation dose used was in the lethal range for mice. At the completion of radiation, the slices of 2 spleens removed from donor mice were placed in the peritoneal cavity of each recipient mouse. Spleens used for implantation were taken from donor animals 3 hr, 1, 2, 4, 7, 10, and 14 days after irradiation. The percentages of mice surviving for 28 days in the 7 groups were: 16.7, 28.6, 11.1, 0, 4.5, 42.9, and 30.8%, respectively. This is in contrast to 2.1% in control mice receiving no spleen graft and 9.5% in those receiving spleen from nonirradiated mice. A possibility for increased protective activity of shielded spleens taken after 3 hr is that noncellular elements of the shielded spleen may play an important role in recovery from radiation injury during the early period following irradiation. (TCO)

**17786** THE INCIDENTAL EFFECT ON THE HEART OF X-RAY IRRADIATION. B. Vinke (Public Health Service, Curacao, Netherlands Antilles). Acta Med. Scand., 172: 711-14(Dec. 1962).

In 40 patients suffering from esophageal carcinoma, electrocardiograms (ECG's) were made before and immediately after x irradiation with a tumor dose of 3000 and 6000 r. In 11 patients ECG's also were made between 3 and 13 months after the end of the irradiation. In all patients, who had either pathological ECG's initially or with normal ECG's in relation to their age, no changes in the ECG pattern could be detected at any postirradiation interval. Postmortem examinations in 5 patients showed no changes in the heart muscle that could be attributed to irradiation. Therefore, it was concluded that irradiation of tumors in or on the chest is far less damaging to the heart muscle or coronary arteries than previously suggested. Although 8 patients were suffering hypertension, atherosclerosis, and hypercholesterolemia, and were therefore prime candidates for coronary occlusion, there was no evidence that cardiac irradiation precipitates coronary accidents. (H.H.D.)

**17787** ELECTROENCEPHALOGRAPHIC STUDIES ON PERSONS WORKING WITHIN THE REACH OF MICROWAVES. Z. Edelwejn and S. Haduch. Acta Physiol. Polon., 13: 431-5(May-June 1962). (In Polish)

A series of periodical examinations were carried out on 120 persons working within fields of high-frequency electromagnetic waves. Case-history analysis and morphological evaluation of the electroencephalographic records showed a significantly large number of complaints submitted by individuals exposed to microwaves for more than three years. Moreover, there was a distinct preponderance of EEG records with subnormal bioelectric activity in the individuals exposed to microwaves for a period of more than one year as compared to those with less than a year's exposure. Successive EEG investigations under metrazol provocation and photostimulation revealed a significantly greater number of positive test changes in individuals exposed to the microwaves for a period longer than three years. (Aerospace Med., Jan. 1963)

**17788** THE INFLUENCE OF IONIZING RADIATION ON PROTEINS IN RADIOSENSITIVE TISSUES. J. Neuwirt, Zd. Pokorný, P. Broulík, and K. Šulc (Charles Univ., Prague). Acta Univ. Carolinae Med., Suppl., 14: 89-94 (1961). (In Czech.)

In rats treated with 600-r doses of x rays, determinations were made of changes in sulfhydryl (mercapto) groups in tissues by amperometric titration and of the uptake of $S^{35}$-labeled methionine. Immediately after irradiation of radiosensitive tissues, such as testis, an increase was noted in protein-bound sulfhydryl groups, both on the basis of tissue weight and N content. At the same time the tissue cysteine content declined. The labeling of organic sulfur compounds after injection of methionine-$S^{35}$ was diminished by irradiation. It was concluded that radiation causes the reduction of disulfide linkages to sulfhydryl groups in radiosensitive tissues, presumably because of the free radicals formed in the primary ionizing reaction. (H.H.D.)

**17789** THE INFLUENCE OF IRRADIATION ON CHANGES IN THE SERUM ACTIVITY OF LACTIC DEHYDROGENASE IN RATS. V. Volek and Zd. Dienstbier (Charles Univ., Prague). Acta Univ. Carolinae Med., Suppl., 14: 103-10(1961). (In Czech.)

Changes in serum lactic dehydrogenase (LDH) activity were followed for 4 hr to 4 weeks after whole-body irradiation with 200-kv x rays. The animals were irradiated at a rate of 32 r/min to total doses of 25, 100, 600, and 1000 r. Four hr after irradiation the serum LDH activity fell except with the highest dose, which produced no effect at this time. The 600-r dose diminished activity 35%. After 24 hr the activity was elevated ~20% by the 3 highest doses; the effect of all 3 was similar. Thereafter the activity tended to decline and fell below normal by the 3rd postirradiation week. Circulating lymphocytes fell sharply and remained low throughout the period, except after 25 r. When the rats were injected with a solution of LDH immediately after irradiation, the serum LDH activity generally remained elevated for 2 to 3 weeks after irradiation. The changes in activity did not follow a consistent pattern in relation to the radiation dose. (H.H.D.)

**17790** CLINICAL AND DIAGNOSTIC ASPECTS OF UROLOGICAL COMPLICATIONS OF GYNECOLOGIC CANCER. E. Hradec, Z. Borek, J. Venta, O. Valenta, and K. Motlík (Charles Univ., Prague). Acta Univ. Carolinae Med., Suppl. 14: 339-64(1961). (In Czech.)

Urological complications occurring in 51 women undergoing surgical and/or radiation treatment are described. Injury to the ureter or urinary bladder as a result of x-ray or radium therapy arose as a rather late effect. In the ureter it appeared as stenosis or fistula and in the bladder as a local lesion, such as telangiectasis, ulcer, and fistula, or as generalized, diffuse damage. Diagnosis of late radiation lesions can be made with urography and cystography. The radioinduced histopathologic changes in the bladder included an increase in fibrous elements, obliterative endovasculitis, capillary angiectasis in the mucosal layer, deep ulceration, and necrosis of muscle fibers and replacement by connective tissue. The late regressive changes in the bladder did not always reach a stationary state, but in some cases continued. (H.H.D.)

**17791** RADIATION JEJUNITIS AND A CHOLEIC-ACID ENTEROLITH. Richard A. Norton, Theodore A. Mahowald, and Lee S. Monroe (Scripps Clinic and Research Foundation, La Jolla, Calif.). Am. J. Digest. Diseases, 7: 634-41 (July 1962).

The case history is presented of a woman who developed jejunal stricture complicated by formation of a deoxycholic acid intestinal stone. Development of this condition was attributed to radiation jejunitis following radiotherapy 20 years earlier for uterine adenocarcinoma. At that time, 4 doses of 2000 r each were given over a 4-week period. A 34-cm segment of jejunum was removed surgically and found to contain a stone 2 cm in dia consisting of 60% deoxycholic acid and 12% fatty acids. Jejunal stricture is rare following radiotherapy and a survey showed that, considering the entire digestive tract, the incidence of stricture following pelvic irradiation is not great, varying from 1.6 to 12.1% of 2696 subjects reviewed. The length of time between the end of therapy and the surgical intervention for small-intestinal symptoms averages 26½ months in a series of 600 patients. Stasis of the intestinal flow would favor bacterial hydrolysis and metabolism of bile cholic acid to deoxycholic acid, thus setting up conditions for the development of enteroliths. (TCO)

**17792** ADENOCARCINOMA OF THE ENDOMETRIUM FOLLOWING RADIATION THERAPY AND ASSOCIATED WITH HILUS CELL HYPERPLASIA. Richard Schuldenfrei, Nikolas A. Janovski, and William B. Ober (Albert Einstein Coll. of Medicine, New York). Am. J. Obstet. Gynecol., 82: 1186-91(Nov. 1961).

The case history is presented concerning a 65-yr-old woman in whom a malignant uterine tumor was found 28 yr after pelvic x irradiation for a benign condition. The estimated mid-pelvis dose was 1350 r. The endometrial adenocarcinoma was accompanied by a proliferation of ovarian hilus cells. The patient had also developed a cecal adenocarcinoma 16 yr after radiotherapy. It is suggested that

x irradiation may have been primarily responsible for both tumors and that hilar hyperplasia may have provided endocrine stimulation acting as a secondary factor in the induction of the endometrial cancer. Thus, irradiation may have acted as the initiating stimulus and excessive hormone output as the promoting factor or cocarcinogen. An extensive review is made of the literature of cases of this type. (H.H.D.)

**17793** EFFECT OF RADIOTHERAPY ON TUMOR-BEARING LYMPH NODES IN CARCINOMA OF THE CERVIX UTERI. J. Botella Llusiá, F. Nogales Ortiz, V. Giménez-Tébar, and J. Zamarriego Crespo (Univ. of Madrid). Am. J. Obstet. Gynecol., 84: 508-14(Aug. 15, 1962).

A study of 60 patients revealed that intensive deep radiotherapy with high doses (5000 to 8000 r) diminished considerably the number of tumor-bearing lymph nodes in carcinoma of the uterine cervix. The incidence of tumor-bearing lymph nodes was 33% in nonirradiated patients and in those receiving 2000-r Ra therapy. This is in contrast to an incidence of 20% and 6.6% in those receiving 6000 and 8000 r, respectively, from combined Ra and 250-kv x-ray treatments. Sterilization of the lymph nodes was not total, even with large doses of radiotherapy, necessitating a combination of radiotherapy and lymphadenectomy for the treatment of Stage III carcinoma. The histologic type of the primary tumor appears to play a decisive role in the formation of lymphatic metastases. They are very scarce (1.3%) in basocellular epithelioma, abundant in spinocellular (38.9%), and prevalent in adenocarcinoma (85.7%). It should be possible to establish a histoprognosis of carcinoma of the cervix. (H.H.D.)

**17794** THE BIOLOGICAL ACTION OF IONIZING RADIATIONS. D. Ruffili (Università, Rome). Ann. Med. Navale Trop., 66: 245-50(Mar.-Apr. 1961).

**17795** THE LEUKEMOGENIC ACTION OF IONIZING RADIATION. Alfredo Spena. Ann. Med. Navale Trop., 66: 369-84(May-June 1961).

**17796** A SUMMARIZATION OF RADIATION PATHOLOGY AND HYGIENE. Alfredo Spena. Ann. Med. Navale Trop., 66: 809-32(Nov.-Dec. 1961).

**17797** IRRADIATION INJURY TO ELASTIC ARTERIES IN THE COURSE OF TREATMENT FOR NEOPLASTIC DISEASE. Raul A. Marcial-Rojas and José R. Castro (Univ. of Puerto Rico, San Juan). Ann. Otol. Rhinol. Laryngol., 71: 945-58(Dec. 1962).

Autopsies were performed on 11 patients who died of massive hemorrhage due to rupture of large elastic arteries following radiotherapy for neoplastic disease. Five had ruptured aortas and 4 died immediately following or during the course of $Co^{60}$ irradiation for unresectable carcinoma of the middle third of the esophagus. The dosage in 3 was ~5000 r, delivered to the tumor in a period of 41 to 47 days. In another, the aorta ruptured during treatment; the patient received 1050 r in 10 days through posterior and anterior fields measuring 5 × 14 cm. Six patients who received x-ray, Ra, or Co therapy for cervical metastases and were later subjected to a radical neck dissection had a ruptured carotid artery, 8 to 34 days after the operation. Macroscopic changes in the arteries were sharply limited to the vessels directly in the field of radiation. A very consistent common denominator was evident in the cases of malignancy treated with irradiation. All had salivary fistulas or infection in the irradiated areas. All 6 cases subjected to radical neck dissection had necrosis of the skin flaps and 5 had salivary fistulae. It is therefore recommended that all patients subjected to combined head and neck operation, after pre-operative irradiation of the neck, be closely followed during the first postoperative month, especially if they develop necrosis of skin flaps and salivary fistulae. By this precaution, radioinduced rupture of the carotid artery may be seen early and corrected by emergency surgery. (TCO)

**17798** ENTOMOLOGICAL ASPECTS OF RADIATION AS RELATED TO GENETICS AND PHYSIOLOGY. Daniel S. Grosch (North Carolina State Coll., Raleigh). Ann. Rev. Entomol., 7: 81-106(1962).

A review is given with 205 references included. (H.H.D.)

**17799** OPERATIVE THERAPY FOR SEVERE IRRADIATIONAL INJURY IN THE ENTERAL AND URINARY TRACTS. Winfred L. Sugg, William H. Lawler, Lauren V. Ackerman, and Harvey R. Butcher, Jr. (Washington Univ., St. Louis and Barnes Hospital, St. Louis). Ann. Surg., 157: 62-70(Jan. 1963).

Histopathologic studies were made of surgical specimens from 105 patients who had undergone surgical corrective procedures for severe radiation injury as a result of radiotherapy for gastrointestinal or genitourinary carcinoma. Cervical carcinoma accounted for most (78). Treatment for complications was required by 67% of the patients during the first 2 yr after receiving radiotherapy. Nearly ⅓ had some type of intestinal or urinary fistula, while ulcerative disease was associated with some degree of luminal obstruction in ½. Correlation of the results of treatment with the type of operative procedure used indicates that operations involving enteral or urinary anastomoses should be associated with proximal luminal diversion. Several years after successful radiotherapy of carcinoma of the cervix uteri, the mucosa of intestine or urinary bladder is moderately atrophic, the submucosa is thickened, fibrotic, and contains no lymphoid tissue, but the muscular wall and blood vessels are normal or nearly so. Dosages of irradiation that destroy smooth muscle fibers and cause vascular endothelial proliferation, subendothelial lipid deposits, and thrombosis are often accompanied by irreversible ulceration, infection, cicatrical obstruction, and at times perforation. The results showed that combined radiation and operative therapies are often associated with serious complications. Irradiated tissues heal poorly when subjected to operative trauma, and tissues recently traumatized by operation do not tolerate ionizing irradiation well. Recommendations for abdominal surgical techniques to be used in irradiated patients are outlined. (TCO)

**17800** INFLUENCE OF GAMMA RADIATION ON THE MICROFLORA OF CUCUMBER FRUIT AND BLOSSOMS. John L. Etchells, R. N. Costilow, Thomas A. Bell, and H. A. Rutherford (North Carolina State Coll., Raleigh). Appl. Microbiol., 9: 45-9(Mar. 1961).

Samples of the fruit and blossoms of cucumber plants were irradiated with doses of 0.05 to 3.0 Mrep in a $Co^{60}$ cell to investigate the effect of γ radiation on the normally occurring microflora on the freshly harvested samples. Doses of 0.5 to 0.75 Mrep reduced the total aerobic and anaerobic bacterial populations to levels equivalent to spore counts and eliminated the coliform and acid-forming bacteria from the samples. Bacterial spores were the most resistant to radiation; anaerobic and aerobic spore forms were recovered from the fruit after dosages of 1.0 and 2.0 Mrep, respectively. Yeasts and molds were considerably more resistant than vegetative cells of bacteria. The microbial destruction pattern for irradiated cucumber blossoms was essentially the same as that for fruit. It was

indicated that, in general, the individual microbial groups in a heterogeneous natural flora occurring on cucumber material responded to radiation in a manner similar to that previously reported of microorganisms. Increasingly higher doses of radiation resulted in correspondingly lower cucumber firmness values as compared with nonirradiated controls. The highest dose (3.0 Mrep) produced ~60% loss of firmness. (TCO)

**17801** EFFECTS OF X-RAY THERAPY ON BASAL CELL CARCINOMA. I. A HISTOLOGIC STUDY OF SERIAL BIOPSY SPECIMENS. Paul M. Crossland (Stanford Univ., Calif.). Arch. Dermatol., 86: 745-52(Dec. 1962).

Histologic changes were followed during the radiotherapy of 3 basal cell carcinomas in skin. The carcinomas received a total of 4400 to 4650 r x irradiation, given in 10 to 13 treatments over a 2-week period. Early in the course of treatment, slight nuclear changes occurred in many resting cells. Small aggregates of condensed chromatin gave the cells a granular appearance. As separation of chromatin and nonchromatic nuclear material became more prominent, the granules of stained material became larger, and nonchromatic material accumulated toward the center of the cells, appearing as a vacuolation. Differentiation of epithelial cells in basal cell carcinomas in the direction of a squamous structure occurred progressively during successful treatment. In keratinized tumor cells the nuclei were usually pyknotic. Cell differentiation was most conspicuous when the tumors showed the most involution during therapy. All tumors showed an increase in degenerating cells at the expense of resting cells during the initial week of irradiation. In one tumor, which responded most rapidly and continued its regression to apparent cure, there was no reversal of the progression of degeneration, and after 14 days nearly all of the cells were degenerated. It was concluded that cure following irradiation of some basal cell carcinomas is related to structural changes that can be seen in the tissue, specifically, mitotic inhibition, cell degeneration, and cell differentiation. It appears that cellular differentiation in basal cell carcinomas is a less consistent result of radiotherapy than in squamous cell carcinomas. (TCO)

**17802** THE EFFECT ON ESCHERICHIA COLI B OF RADIOPROTECTORS PRODUCED BY FERMENTATION. F. Hernádi, I. Békési, Z. Nagy, A. Jeney, and T. Vályi-Nagy (Debrecen Medical Univ., Hungary). Arch. Mikrobiol., 44: 228-32(1962).

The possibility of the formation of a radioprotectant compound during bacterial growth was investigated. The radioprotective activity of several hundred fermentation liquids was examined. Of the fermentation liquids tested, good protective ability was rendered, mainly after acid hydrolysis, by the fermentation liquor from a Penicillium notatum strain used in industry. This agent was shown to be D-penicillamine. Its radioprotective activity and its ability to reduce the toxicity of nitrogen mustard were compared with the effect of other well-known radioprotectants, on an equimolar basis. Its protective ability on E. coli B against $LD_{90}$ doses of x rays and nitrogen mustard was about the same as that of cysteine. However, it was only half as effective against x radiation as cysteamine and AET. It was less effective in protecting the cells against radiation than in assisting their recovery from radiation injury. (H.H.D.)

**17803** EXPERIMENTAL STUDIES ON THE ACTION OF GAMMA RAYS FROM RADIUM AND $Co^{60}$ ON THE CARTILAGE OF RABBIT LARYNX. B. Minningerode (Universität, Gottengen, Ger.). Arch. Ohren, Nasen, Kehlkopfheilk., 177: 485-521(1961).

Comparative effects of the irradiation of cartilage by implanted Ra and $Co^{60}$ were investigated histologically. Capsules containing 2 or 10 mg Ra (with a 0.2-mm Pt filter) and 1.2 or 6 mC $Co^{60}$ were imbedded in the soft tissue srrounding the laryngeal cartilage, where they remained for various periods to give local doses up to 10000 r. The conditions used approximated those employed in the radiotherapy of human carcinoma of the vocal cords. The initial reaction, seen macroscopically, consisted of swelling and edema of the cartilage, accompanied by vasodilatation and petechial hemorrhages. Microscopically, the first change was cellular proliferation, the degree of which increased with the radiation dose up to about 2500 r; above this dose, regressive changes became more and more severe. At more moderate doses, cell numbers reached twice the normal count. In addition to hyperplasia, hypertrophy of cartilage cells was also noted at the higher doses. Irradiated cartilage was characterized by both repair and degenerative phases, with the latter predominating if cellular injury is severe. Late changes, as seen macroscopically, included thickening and fibrosis of the cartilage capsule, adhesions between it and adjacent connective tissue, and local areas of necrosis and fibrosis in cartilage. Ra and $Co^{60}$ caused qualitatively similar changes; however, the late sequellae appeared at different intervals with the 2 sources. It is proposed that local irradiation with $Co^{60}$, rather than with Ra, be used in the treatment of cancer of the vocal cords, since at equivalent radiation doses, $Co^{60}$ leaves less residual scarring. (P.C.H.)

**17804** THE RELATION OF RADIATION DOSE TO RADIATION DAMAGE IN THE MANDIBLE OF WEANLING RABBITS. M. A. Rushton (Guy's Hospital, London), Maureen Owen, W. Holgate, and Janet Vaughan. Arch. Oral Biol., 3: 235-46(June 1961).

Weanling rabbits injected with a single dose of $Sr^{90}Cl_2$ in amounts from 100 to 1000 $\mu$C/kg were killed at intervals up to 180 days. Autoradiographic and dosimetric studies were performed on the mandibles of one side and histological studies on the other. The pattern of $Sr^{90}$ retention in the teeth differed in rabbits given 600 $\mu$C/kg or more from those given 100 $\mu$C/kg or less, owing to retardation of tooth eruption and growth in the former group. Dose rates were measured along two lines in the mid-vertical plane of the mandible and variations in dose rate with time after injection for rabbits of higher and lower injected doses were recorded. Variation of accumulated dose with time after injection was also calculated. Severe and early changes in tooth growth occurred after the higher injected doses, teeth becoming narrower, retarded, or arrested in growth. Alveolar bone ceased to grow, but 2 to 3 months after injection, pleomorphic osteoblastic proliferations arose on the surface of sockets and by 6 months resorption of tooth and bone accompanied growths regarded as osteosarcomas. No tumors arose from dental tissues. The accumulated dose at the tumor sites was 7500 to 9000 rad, and several tibial osteosarcomas were noted, occurring at doses of 10000 to 15000 rad. The sites of osteogenic sarcoma in the mandible and in the long bones were similar. (H.H.D.)

**17805** RADIOACTIVE FALLOUT EFFECTS ON SKIN. I. EFFECTS OF RADIOACTIVE FALLOUT ON SKIN OF ALAMOGORDO CATTLE. Carl F. Tessmer (Armed Forces Inst. of Pathology, Washington, D. C.). Arch. Pathol., 72: 175-90(Aug. 1961).

The effect of $\beta$ radiation on various histologic elements in skin was investigated in cattle exposed to the July 1945 nuclear weapons test and biopsied or autopsied 5 months to 13 yr later. In biopsies obtained in 1949, the most severe involvement was noted along the central area of the back as irregular areas of complete epilation, depigmentation, and crusted and granular skin surface with variable keratin and hornlike projections. In 1956, essentially the same pattern was present, with irregular areas of epilation, depigmentation, scarring, crusting, and variable graying of the hair. There was a notable increase in the size of the keratin and cutaneous hornlike projections. Histologically, the areas exposed to radioactive fallout for 5 months presented irregular epidermal thickness, with areas of thinning as well as abnormal thickening and mild hyperkeratosis and parakeratosis. After $4\frac{1}{2}$ yr the most striking change was combined excessive hyperkeratosis and acanthosis. The epidermal pattern of later lesions (11 to 13 yr) showed acanthosis and hyperkeratosis of variable degree. Biopsies at 5 months showed reduced or absent hair follicles, a well-demarcated depth of recent fibrous tissue response, and numerous persistent arrector pili muscles with frequent degenerative changes. While the elements of these responses described are either a degenerative, reparative, or even a proliferative response to injury, the combination is believed to be relatively unique, characteristic of radiation, and considered as a relatively specific lesion. However, the later lesions contain fewer distinctive changes and present progressively greater difficulty in identification as lesions secondary to radiation effect. (TCO)

**17806** EFFECT OF SLIGHT RADIATION DOSES IN THE IRRADIATION OF SEEDLINGS. A. Suess (Bayerische Landesanstalt fllr Bodenkultur, Pflanzenbau und Pflanzenschutz, Munich). Atompraxis, 9: 86-92(Mar. 1963). (In German)

The results obtained by irradiating grain, potatoes, and maize are reported. It was found that there may be an improvement in yield, depending upon the type of grain, the particular sort used, and vegetation conditions. Among the yield factors frequently influenced by radiation are the number of kernels per head in grains and the number of tubers in potatoes. Nutrient uptake also appears to be connected with the extent of radiation effect; in the irradiated plants there was a marked increase in uptake. An increase in growth was also found in subsequent years following irradiation. (auth)

**17807** THE COMPARABILITY OF RADIOPHYSIOLOGICAL STUDIES ON HIGHER PLANTS. PART II. T. von Kreybig (Universitllt, Vienna). Atompraxis, 9: 95-8(Mar. 1963). (In German)

A physiological classification of the effect of radiation on higher plants is proposed. It is demonstrated with reference to experimental results. The varying radiation resistance of individual cells and tissues of a particular plant, as well as the resultant difference in the effects, was examined with the use of these categories. Differences in dose toleration found among the individuals of a particular species are presented. (auth)

**17808** BEHAVIORAL EFFECTS OF SMALL DOSES OF ACUTE X-IRRADIATION ADMINISTERED PRENATALLY. J. Werboff, J. Havlena, and M. R. Sikov (Wayne State Univ., Detroit). Atompraxis, 9: 103-5(Mar. 1963). (In English)

Five and 15 r of x radiation was administered to gravid rats after 5, 10, 15, or 20 days of gestation and the offspring evaluated on a battery of developmental and behavioral measures. No consistent or significant behavioral alterations were observed. This was in contrast to previous studies at radiation dosages between 25 and 100 r. It was, therefore, concluded that the threshold for behavioral consequences with the parameters described must be between 15 and 25 r. These results are discussed in relation to other studies reporting significant effects from these same dose levels but administered earlier in gestation. The need for additional experimental verification was suggested. (auth)

**17809** LIMITING FACTORS IN THE USEFULNESS OF RADIATION-INDUCED MUTANTS IN PLANT BREEDING. W. Gottschalk (Universitllt, Bonn). Atompraxis, 9: 105-8 (Mar. 1963). (In German)

Examination of a large assortment of radioinduced mutants of Pisum sativum showed that even the most productive mutants have only limited possibilities for use in practical plant breeding. In almost all the forms examined, the mutated gene is responsible not only for the positive characteristics found, but also for the negative ones as well. This pleiotropy of gene effect is very widespread, and forms a limiting factor in mutational breeding. In rare cases the productive level of mutants is further lowered by penetrative weakening of the mutated genes. (auth)

**17810** THE ACTION OF IRRADIATED SPERM IN NORMAL FECUNDATION AND IN PSEUDOGAMIA IN PLANARIA. Mario Benazzi (Università, Pisa, Italy). Atti. Accad. Nazl. Lincei. Rend., Classe Sci. Fis., Mat. Nat., (8) 32: 286-9(Mar. 1962). (In Italian)

A study was made to determine the effects of radiation on sperm according to whether the sperm complete normal fertilization or act only as ovum activator. Dugesia lugubris populations with one anfimittic diploid biotype and two pseudogamic biotypes were used. The animals were exposed to x rays at doses from 2000 to 5000 r. The results show clearly that the radiation effects are different if the sperm penetrate an anfimittic or pseudogamic egg. In the first case, the sperm can complete a normal fertilization, but the embryonic development is arrested. In the second case there is normal development and birth of living young. (J.S.R.)

**17811** TUMORS AND DEVELOPMENTAL ANOMALIES IN WISTAR RATS IN THE FIRST GENERATION AFTER MATERNAL WHOLE-BODY IRRADIATION WITH 270 r ON THE 18th DAY OF GESTATION. G. Wegner, E. Stutz, and F. Buechner (Universitllt, Freiburg i. B.). Beitr. Pathol. Anat. Allgem. Pathol., 124: 396-414(July 1961).

On the 18th day of pregnancy, 47 rats were irradiated with 180-kv x rays and the 147 surviving offspring were examined throughout life for evidence of radioinduced effects. Of the 1st generation offspring, 25% developed malignant or benign tumors 12 months or later after irradiation in utero. The death rate from tumors reached a maximum after 23 months and another, higher maximum after 29 months. The tumors were principally sarcomas of various degrees of differentiation, adenocarcinomas of uterus, ovary, kidney, and small intestine, squamous cell carcinomas of skin, pheochromocytoma of adrenal, pancreatic islet-cell adenomas, and Leydig-cell tumors of testis. In 92% of the rats studied, anomalies of the central nervous system, of varying degrees of severity, were noted, ranging from microencephaly with incomplete formation of corpus callosum to anencephaly. Large-chambered renal cysts were found in 4.7%. Rats with brain defects often were dwarfed and showed diminished vitality. The absence of mammary tumors in the rats, in contrast to findings in control animals and animals irradiated at other stages of life, may be attributed to ovarian atrophy. In 26% of the

irradiated mother rats, tumors were observed, principally mammary fibroadenomas and uterine polyps. The same incidence (23 to 30%) was found in young rats irradiated with a single 270-r x-ray dose on the 13 to 49th day of life. (H.H.D.)

**17812** THE ACTION OF LONG-TERM IRRADIATION WITH RADIOACTIVE STRONTIUM ($Sr^{90}$) ON RAT KIDNEY. H.-W. Altmann, R. Lick, and E. Stutz (Universität, Wurzburg, Ger.). Beitr. Pathol. Anat. Allgem. Pathol., 127: 78-110(Oct. 1962).

Plastic capsules containing 30 to 50 μC $Sr^{90}$ (and its daughter product $Y^{90}$) were imbedded in renal parenchymal tissue, and 8 to 9 months later the kidney was examined histologically. It was evident that tissue injury declined sharply as distance from the capsule increased; over a distance of a few millimeters the difference in tissue damage was marked. Tissue injury surrounding the capsule was divided into 3 zones: an inner region of necrotic, autolyzing tissue fragments; a middle zone of shrinkage of glomerular and tubular structures; and a peripheral area of minimal changes. In the inner zone the only detectable histologic structures remaining were the reticulin fibrils and basement membranes, which previously surrounded the tubules and glomerular capillaries. Appropriate stains also revealed proteins, glycoproteins, and fibrin within this area. The inner zone was completely devoid of nuclei, blood vessels, leukocytes, and connective tissue cells of any kind. In the more or less sharply demarcated central zone, cell destruction, atrophy, and scar formation predominated. In the outer, peripheral zone, similar but less marked changes in tubules were noted, and many glomeruli were atrophic and nonfunctional. Blood vessels showed relatively little injury in the outer zones, and it was concluded that the tubular epithelial cell is the most radiosensitive renal cell. (TCO)

**17813** LEUKEMIA AS A POSSIBLE DEVELOPMENT IN RADIOTHERAPY OF CARCINOMA OF THE CERVIX UTERI. M. Thiery and S. Ringoir (Rijksuniversiteit, Ghent). Belg. Tijdschr. Geneesk., 17: 524-30(May 15, 1961).

A case history is described in detail. (H.H.D.)

**17814** REACTIVATION OF IRRADIATED ESCHERICHIA COLI B BY RIBONUCLEASE. Frank T. Gardner (Yale Univ., New Haven). Biochem. Biophys. Res. Commun., 10: 454-9(Mar. 25, 1963).

The addition of ribonuclease to an actively growing culture of Escherichia coli after exposure to $Co^{60}$ γ radiation resulted in a substantial increase in survivors. Results indicate that the ribosomal ribonucleic acid may be the fraction of the cell ribonucleic acid in which radiation damage causes the most lethal effect. (C.H.)

**17815** THE EFFECT OF ULTRAVIOLET LIGHT ON PHOTOPHOSPHORYLATION AND THE HILL REACTION. N. Shavit and M. Avron (Weizmann Inst. of Science, Rehovoth, Israel). Biochim. Biophys. Acta, 66: 187-95(Mar. 19, 1963). (In English)

Photophosphorylation and Hill-reaction activity of swiss-chard chloroplasts or chloroplast fragments were decreased by irradiation with short-wavelength ultraviolet light. Photophosphorylation was more resistant to irradiation than the Hill reaction. The presence of ascorbate during irradiation prevented the decrease in Hill reaction and photophosphorylative activity although the effect was greater for the Hill reaction. It is suggested that ascorbate protects mostly by reducing the effective ultraviolet intensity, and in addition by exerting a specific effect on the chloroplasts themselves. By ultraviolet irradiation, it was possible to obtain chloroplast preparations that had lost the ability to perform the Hill reaction, but still possessed high photophosphorylative activity. The endogeneous plastoquinone of chloroplasts was shown to be destroyed by irradiation. The activity of irradiated chloroplasts was stimulated by the addition of plastoquinone. However, a similar stimulation was obtained on addition of plastoquinone to nonirradiated chloroplasts. (P.C.H.)

**17816** EFFECTS OF LOW TEMPERATURES ON POST-RADIATION CHANGES IN EGGS OF BOMBYX MORI L. Anna Kostolanská. Biologia, No. 8, 626-8 (1962).

Eggs (2400) of Bombyx mori L. were divided into three groups: (I) stored in refrigerator for 4 months at +5 °C served as control; (II) was irradiated with 4000 r and afterwards stored in refrigerator under the same conditions as (I); and (III) was irradiated with 4000 r after being stored for 4 months at +5°C. The changes through irradiation were determined by measuring the $O_2$ uptake with Warburg's respirometer. Irradiation generally reduced the $O_2$ uptake. A period of cooling after irradiation weakened its effect (the oxygen uptake of group (II) was only slightly lower than that of (I)). (OTS)

**17817** AUTORADIOGRAPHIC STUDIES ON THE EFFECT OF X RAYS ON THE UPTAKE OF $C^{14}$-OROTIC ACID BY EHRLICH ASCITES CELLS. A. Vorbrodt (Coll. of Agriculture, Poznan, Poland). Bull. Acad. Polon. Sci., Ser. Sci. Biol., 10: 111-16(1962).

Ehrlich ascites cells incubated at 0°C incorporated much less orotic acid than those incubated at 37°. The percentage of labeled cells rose only over the first hour, and further incubation was unable to increase the precursor's incorporation. This indicates that at low temperatures penetration of orotic acid into cells is independent of metabolic activity. The rapid numerical increase of labeled cells and of the grains over nucleus and cytoplasm noted in the autoradiogram on incubation at 37° seems to be due to metabolic activity and RNA synthesis. On treatment with ribonuclease, radioactivity vanished in most of the cells, which suggests that nearly all the orotic acid was incorporated in RNA. Irradiation with 2300 r clearly depressed the percentage of labeled cells and modified the distribution of radioactivity as revealed by the localization of the grains. The number of cells with grains over nucleus and cytoplasm was larger after irradiation. It appeared that x rays had in some way promoted the precursor's penetration into the cells. On further incubation of unirradiated preparations, the number of cells with radioactivity in both the cytoplasm and nucleus increased rapidly. All nonirradiated cells were labeled after 2-hr incubation, whereas in irradiated preparations an increase occurred only in the percentage of cells, with the precursor either only in nucleus or only in cytoplasm. (H.H.D.)

**17818** LOCAL AND GENERAL CHEMICAL PROTECTION AGAINST EPILATION BY X IRRADIATION. Z. M. Bacq, M.-L. Beaumariage, and D. V. Radivojevitch (Université, Liège). Bull. Acad. Roy. Med. Belg., 7: 519-50 (1961).

Changes in skin and hair growth were investigated in C57 mice exposed to 200- to 700-r doses of whole-body x radiation at the age of 5 to 8 days. It was noted that hair follicles were more resistant in the younger mice; the threshold epilating dose was ~400 r in 5-day-old mice compared with 300 r in 8-day-old mice. The 700-r dose consistently and completely inhibited hair growth at the

age of 5 days, accelerated epilation at the age of 8 days, and retarded regeneration. After 700 r, ~1 month was required for hair regrowth, and after 300-400 r, ~3 weeks. Cysteamine (250 to 750 μg), cysteine, and MEG (mercaptoethylguanidine) gave local protection while cystamine (250 to 750 μg) gave generalized protection against epilation. Histamine, injected in sufficiently high dosage (1.1 mg) in skin or peritoneum, afforded complete protection of hair follicles, and weaker doses (11 μg) of histamine or of a histamine liberator (Compound 48/80, 1.5 μg) gave local protection when injected in skin. Subcutaneously administered tryptamine (156 μg) or 5-hydroxytryptamine (8.5 to 1150 μg) gave generalized protection against epilation, and small doses (31 to 62 μg) of tryptamine gave local protection. Antihistamine agents (Phenergan, Neoantergan, Antistine), when injected in 10-μg doses in skin or 90-μg in peritoneum 30 min before administration of radioprotectants: consistently abolished the local and general protection conferred by histamine; diminished in half the mice tested the local protection afforded by low doses of cysteamine; and did not inhibit the general protection given by cystamine. Bol-148, an antagonist of 5-hydroxytryptamine, when injected 30 min before 5-hydroxytryptamine or tryptamine, inhibited the local and general protection given by the latter amines. Among the other agents tested for anti-epilatory action against x irradiation, significant protection was afforded by diethydithiocarbamate and ethylenediaminetetraacetic acid, but not by 8-hydroxyquinoline-5-sulfonic acid. It is suggested that, in mammals at least, the mechanism of action of cysteamine and MEG does not involve the induction of tissue anoxia. No explanation could be offered why cysteamine (containing an SH group) was not systemically protective against epilation nor why cystamine (the S-S form) afforded systemic protection. It is proposed that the protection given the hair follicle by histamine, tryptamine, and 5-hydroxytryptamine is, at least in part, due to their promotion of tissue hypoxia. (TCO)

**17819** ROLE OF IRRADIATION WITH X RAYS ON THE APPEARANCE OF MAMMARY OR OVARIAN TUMORS ACCORDING TO THE STRAIN AND AGE OF THE MICE. M.-R. Rivière, I. Chouroulinkov, C. Marty, and M. Guérin (Institut de Recherches Scientifiques sur le Cancer, Villejuif, France). Bull. Assoc. Franc. Etude Cancer, 49: 206-16(Apr.-June 1962).

Prepubertal and adult mice (aged 4 to 6 weeks and 4 to 6 months, respectively) were exposed to a single whole-body 300-r dose of x rays and development of the tumors was followed. Three strains of mice were studied: IC strain, in which mammary tumors are rare; C3He/A, which lacks the milk factor; and XLII, which never develops mammary tumor. Only a few mammary tumors developed and only in the IC strain; the incidence rate was 6% in nonirradiated controls and 2% in both of the irradiated groups. This confirms previous findings that irradiation retards the appearance of mammary tumors. Ovarian tumors were completely lacking in nonirradiated mice of the IC and XLII strains, but present in C3He/A controls in 6 and 9% of the young and old groups, respectively. It also appeared that younger mice were more susceptible to x-ray induction of ovarian tumors. Two types of ovarian tumors predominated, namely, folliculotubular and luteal. (TCO)

**17820** BONE MARROW REPLACEMENT: PRINCIPLES AND APPLICATIONS. H. E. M. Kay (Royal Marsden Hospital, London) and P. C. Koller. Cancer Progr., 33-48 (1960).

A review of the use of bone marrow grafts after radiotherapy of malignant diseases is presented. (H.H.D.)

**17821** THE EFFECTS OF HEAT AND RADIATION ON CANCERS IMPLANTED ON THE FEET OF MICE. George Crile, Jr. (Cleveland Clinic Foundation). Cancer Res., 23: 372-80(Mar. 1963).

Heating of S91 melanoma in DBA/1 mice or S-180 in SWR mice to 44°C for from 30 to 40 minutes destroyed a high proportion of the tumors without damage to the feet on which the tumors were implanted. Heat and radiation were synergistic or at least additive in their effects on tumors when treatments with heat and radiation were given within a few hours of each other regardless of which agent was administered first. Moderate exposures to heat and radiation when given close together cured some radioresistant tumors that could not be cured by larger doses of radiation without destroying the mice's feet. Small tumors were more radiosensitive than large ones, and large ones were more heat-sensitive than small ones. After exposure to one-third of a lethal dose of heat, tumors and normal tissues became heat-resistant and were not damaged by exposures that normally destroy them. Tumors were transplantable immediately after exposures to heat that are lethal to them when they are left in situ. Injection of serotonin into tumors enormously increased their susceptibility to heat. Repeated injections of serotonin without heating resulted in inhibition of growth rate of S-91 melanomas. The chemical changes of the inflammatory reaction that follows heating should be studied in the hope of developing cancerocidal compounds whose injection might reproduce the destructive effects of heat on cancer. (auth)

**17822** THE BIOLOGICAL EFFECTS OF IONIZING RADIATION. Gordon B. Avery (Naval Hospital, Bethesda, Md.). Clin. Proc. Children's Hosp., 17: 146-50(June 1961).

The effects of radiation at the cellular level, particularly with respect to nuclear deoxyribonucleic acid, are reviewed. (H.H.D.)

**17823** DIFFERENCES IN THE APPEARANCE OF TUMORS OF THE OVARY ACCORDING TO THE AGE AND STOCK OF MICE EXPOSED TO WHOLE-BODY X RADIATION. M. R. Rivière, I. Chouroulinkov, C. Lasne, and M. Guérin (Institut de Recherches Scientifiques sur le Cancer, Villejuif, France). Compt. Rend. Soc. Biol., 156: 1605-7(1962). (In French)

Mice of different stock, exposed to whole-body x radiation of a single dose of 300 r, have ovarian tumors in a high percentage of cases with respect to those observed in sample animals. This rate is variable according to the racial line used. The radioinduced heightening of tumor incidence is more marked in young irradiated mice than in adult irradiated mice. (tr-auth)

**17824** ACTION OF WHOLE-BODY X RADIATION, APPLIED AT DIFFERENT DOSES, ON THE APPEARANCE OF METASTASES OF A TRANSPLANTABLE MAMMARY EPITHELIOMA OF RATS. M. R. Rivière, I. Chouroulinkov, and M. Guérin (Institut de Recherches Scientifiques sur le Cancer, Villejuif, France). Compt. Rend. Soc. Biol., 156: 1607-11(1962). (In French)

A whole-body x irradiation administered to male Wistar rats, carriers of a transplantable mammary epithelioma graft G6, has a very marked effect on the appearance of metastases in the tumor. This action varies as a function of the irradiation dose and of the time of its application after the tumor graft. Pulmonary metastases develop in a much smaller percentage of cases. The rate of ganglion

metastases, which usually does not exceed 2%, is increased to 70 and even 80% in some series of irradiated rats. Thus, x rays, in whole-body irradiation, seem unfavorable to the appearance of metastases by blood paths and favorable to lymphatic metastases of the G6 tumor in the rat. (tr-auth)

**17825** SYSTEMATIC MICROSCOPIC STUDY OF THE EFFECT OF IONIZING RADIATIONS ON ANIMAL CELLS IN CULTURE. I. ACTION OF MASSIVE DOSES OF X RAYS. J. Driessens, P. Cappelaere, G. Giaux, and G. Decoster (Institut de Recherches sur le Cancer, Lille). Compt. Rend. Soc. Biol., 156: 1650-3(1962). (In French)

Application of massive x-ray doses (38,000 r) to a culture of striated muscle cells of 9-day chicken embryo causes, in addition to the well-known lesions of the mitoses and chromosomes, alterations of the mitochondria, the cellular membrane, and principally the sum total of cytoplasm which literally explodes with secondary reunification. The nucleus is more or less expelled from the cell until death occurs. No mention of the possibility of this method of cellular death was found in the literature. (tr-auth)

**17826** RADIOBIOLOGY. I. BIOLOGICAL EFFECTS OF NONIONIZING RADIATIONS. J. C. Roucayrol. Concours Med., 83: 5931-8(Nov. 18, 1961).

**17827** RADIOBIOLOGY. II. BIOLOGICAL EFFECTS OF IONIZING RADIATIONS. J. C. Roucayrol. Concours Med., 83: 6247-50(Dec. 2, 1961).

**17828** PRINCIPLES OF BIOLOGICAL EFFECTS OF RADIATION AND RADIATION INJURY. Hans-Dietrich Bergeder (Universität, Bonn). Ergeb. Allgem. Pathol. Anat., 42: 1-33(1962). (In German)

The effects of ionizing radiations on biological systems are reviewed and 167 references are cited. (H.H.D.)

**17829** EXPERIMENTAL RADIATION INJURY TO THE CENTRAL NERVOUS SYSTEM. Norbert Schuemmelfeder (Universität, Bonn). Ergeb. Allgem. Pathol. Pathol. Anat., 42: 34-92(1962). (In German)

The histopathologic effects of ionizing radiation on the brain are reviewed. 237 references are included. (H.H.D.)

**17830** IRRADIATION AS A POSSIBLE PROTECTION AGAINST THE EFFECTS OF MIDDLE CEREBRAL ARTERY OCCLUSION. B. L. Crue, Jr., W. F. Agnew, E. M. Todd, and D. R. Baker (Huntington Memorial Hospital, Pasadena, Calif.). Exptl. Neurol., 6: 340-8(Oct. 1962).

In view of the improved recovery rate after acute coronary artery occlusion in dogs submitted to prior cardiac irradiation, experiments were undertaken to see whether a similar finding could be obtained in the central nervous system. Left middle cerebral artery occlusion was performed surgically in 41 dogs, of which 16 were head-irradiated with 1000 to 2000 r from a $Co^{60}$ source. In all of the nonirradiated controls in which the middle cerebral artery was found to be occluded 4 weeks after surgery, hemiparesis was demonstrated and a pale infarct found on postmortem examination. Of 13 irradiated animals operated 4 weeks after irradiation and in which the middle cerebral artery occlusion was conformed, 7 exhibited clinical hemiparesis, and an even larger infarct; but all the infarcts were hemorrhagic. None of the irradiated dogs receiving 1000 or 1500 r showed significant ill effects after irradiation, but several that received 2000 r showed malaise and loss of appetite for a few days following irradiation. Preliminary studies in rats, in which half of the head was irradiated while the other half was shielded, did not reveal any radioinduced increase in cerebral vascularity. (TCO)

**17831** BIOCHEMISTRY OF NORMAL AND IRRADIATED STRAINS OF HYMENOLEPIS DIMINUTA. Donald Fairbairn, Guta Wertheim, Robert P. Harpur, and Everett L. Schiller (Johns Hopkins Univ., Baltimore). Exptl. Parasitol., 11: 248-63(Sept. 1961).

An irradiated strain of H. diminuta was developed in which morphological anomalies persisted for at least 7 generations. This and the normal strain from which it was derived were compared for biochemical differences, which might lead to the discovery of a biochemical lesion. No significant differences were found in fresh weights between normal and irradiated strains of H. diminuta. Samples of H. diminuta were then prepared, and their composition determined. There was a notable loss of carbohydrates by tapeworms during 24 hr of in vivo fasting, amounting to 56% and 62% in the normal and irradiated strains, respectively. On the other hand, lipids increased by 10% and protein by 4% in both strains, which suggests that the substances were not concerned with energy metabolism during starvation. The glycogen of both normal and irradiated strains of H. diminuta obtained from fed or fasted rats, determined directly or after maintenance of the parasites in glucose-saline, accounted for 99% of the alkali-stable carbohydrates, which in turn, comprised about 96% of the total carbohydrates. In general, no notable differences in the growth, chemical composition, or gross metabolism between normal and irradiated strains of H. diminuta were recognized. Thus, the morphological changes due to irradiation previously described are the reflection of biochemical events. (H.H.D.)

**17832** THE SIGNIFICANCE OF THE PECULIARITIES OF ENERGETIC STATES OF MACROMOLECULES FOR UNDERSTANDING RADIOBIOLOGICAL PHENOMENA. L. Kh. Eydus. Fiz. Khim. i Strukt. Osnovy Biol. Yavlenii, Akad. Nauk SSSR, Inst. Biol. Fiz., Sb. Rabot., 133-41 (1960).

The understanding of the action of radiation on living organisms by the structural peculiarities of biological macro-molecules is discussed. The migration of absorbed energy to weak spots in the structure of the organism, and the conservation of part of the energy in so-called excited states, which exhibit a disturbed electron structure, are also discussed. The physiological and physicochemical nature of radiation after-effects is considered, and the reaction of objects, after radiation, to a fall in temperature is explained in terms of the excited states. Some experiments on myosin, which use adenosine triphosphatase activity to estimate radiosensitivity and seek to prove the occurrence of migration and conservation of energy and to analyze the radiobiological phenomena, assuming the occurrence, are described. A protective mechanism, which involves the transfer via conductors of radiation energy from the protected object to the protector, is suggested. The role of oxygen in radiobiological phenomena is considered to involve a two-stage process in which oxygen acts by reacting with excited molecules and inactivating them, and not by participating in water radiolysis. Also, the possible relation between excited states and the toxic factors, which appear at the time of radiation, are considered. (P.C.H.)

**17833** MORPHOLOGICAL CHANGES IN INTERNAL ORGANS OF ANIMALS PRODUCED BY THE ACTION OF CENTIMETER WAVES ON THE ORGANISM. S. F. Gorodetskaia. Fiziol. Zh., Akad. Nauk Ukr, RSR, 8: 390-6 (May-June 1962). (In Ukrainian)

A short time after irradiation of mice with 3-cm electromagnetic waves (0.4 $w/cm^2$) there appear distinct hemo-

dynamic disorders, hyperemia and hemorrhages in almost all internal organs. Protein dystrophy leading to microne-croses in the heart and liver was noted in almost all cases. Investigation of the sexual organs disclosed that the ovaries were affected to a significantly greater extent than the testes. A control series in which warming by heat convection was employed produced less marked and quickly regressing changes in the hemodynamics. (P.C.H.)

**17834** CHARACTERISTICS OF PHYSIOLOGICAL AND BIOCHEMICAL SHIFTS ASSOCIATED WITH THE PROTRACTED ACTION OF SMALL DOSES OF $Co^{60}$ GAMMA-RAYS ON ORGANISMS. R. S. Zlatin, O. F. Makarchenko, and M. F. Sirotina. Fiziol. Zh. SSSR, 8: 567-71(1962).

Higher nervous activity (using the alimentary secretion method), peripheral blood composition, and some biochemical factors were studied in six dogs (4 experimental animals and 2 controls), the experimental animals being subjected to chronic whole-body irradiation with very small doses (0.05 r during 6 hr) of the $Co^{60}$ gamma radiation. The experiment lasted 3 years. Three characteristic stages were found in the changes of higher nervous activity. The first stage lasted $1\frac{1}{2}$ to $2\frac{1}{2}$ months and was characterized in the case of strong-type dogs by the variation of positive conditioned reflexes within the standard limits. For weak-type dogs the positive conditioned reflexes first increased and then reverted to the initial value, while the latent period is shortened. The second stage lasted from 7 to 18 months and was characterized by the decrease of positive conditioned reflexes and by further extension of the latent period. The third stage (which lasted to the end of the experiment) was characterized by the low level of reflexes, their latent period being longer than the initial value. The hematological changes were characterized by a drop of leukocyte count in the lower limit of the norm during the last 8 months of irradiation by a polycythemic reaction, an increase in the number of thrombocytes from the 5th to the 30th month of irradiation, and by the absence of degenerative changes. (P.C.H.)

**17835** ATTEMPT TO TREAT MALIGNANT TUMORS WITH LARGE DOSES OF NITROGEN MUSTARD OR X-RAYS AND AUTOLOGOUS BONE MARROW GRAFTS. V. Kolář, Z. Mechl, Jiřina Sakalová, and Libuše Švábeniková (Inst. of Oconogy, Brno). Folia Biol. (Prague), 9: 34-41(1963). (In English)

Eighteen patients with disseminated tumors and two with small, localized tumors of varying types and localizations were treated with large doses of nitrogen mustard and autologous bone marrow. In two patients the operation was performed twice. Three other patients were irradiated with a whole-body dose of 200, 400, and 600 r instead of being given nitrogen mustard. Hematological changes, tolerance of large doses of nitrogen mustard, and toxic manifestations, and therapeutic results are discussed. (auth)

**17836** EFFECTS OF MITOMYCIN AND ALPHA-RAYS ON THE CAPACITY OF ESCHERICHIA COLI B FOR PHAGE T3. F. Herčík (Inst. of Biophysics, Czechoslovak Academy of Sciences, Brno). Folia Biol. (Prague), 9: 42-50(1963). (In English)

Effect of mitomycin C (MC) on the capacity of E. coli B was studied both prior to and after irradiation of cells with alpha rays. It was found that MC reduces the capacity at a much greater rate when it is added after irradiation. However, the combined effect of both agents is relatively smaller than when they act separately. The results obtained permit a preliminary conclusion to be made that changes in the deoxyribonucleic acid molecule of the bacterium due to radiation and MC are qualitatively different as far as phage forming capacity of the bacteria is concerned. (auth)

**17837** THE "DIRECT" AND "INDIRECT" EFFECTS OF IONIZING RADIATION ON THE ALGA ZYGNEMA. Jarmila Petrová (Charles Univ., Prague). Folia Biol. (Prague), 9: 51-9(1963). (In English)

From the results obtained with zygnema it was concluded that the direct effect of radiation manifests itself by long lasting damage which can be caused only by a hit of the nucleus and the indirect effect of radiation appears as a temporary effect caused by irradiating the cytoplasm. (auth)

**17838** FINDINGS ON RADIOSENSITIZATION WITH CYCLOHEXANOL. M. Nannelli and C. Vallecchi (Università, Florence). Giorn. Ital. Chemioterapia, 6-9: 230-2(July-Sept. 1962). (In Italian)

The radiosensitizing effect of cyclohexanol was tested with rabbit depilation and rat mortality studies. Clinical therapeutic observations on treatment of cutaneous epithelioma with combined x-ray therapy and administration of cyclohexanol were made to determine the effect of the chemical on the response to irradiation. The results showed that the cyclohexanol lowered the dose required for adequate treatment of the epithelioma. These results are preliminary and the parameters of this effect are still to be determined. (J.S.R.)

**17839** RADIOPROTECTION IN THE GUINEA-PIG BY MEANS OF MESO-2-3-DIMERCAPTOSUCCINIC ACID (DTS). E. Cugurra and E. Balestra (Università, Genoa). Giorn. Ital. Chemioterapia, 6-9: 233-4(July-Sept. 1962). (In Italian)

The radioprotective effect of DTS was studied on guinea pigs exposed to 800, 600, 400, and 300 r in single doses. The DTS was injected one hr after irradiation and continued for seven days. Lethality on the 30th day was used as the standard to determine the radioprotective efficiency of DTS. It had no effect on the animals receiving 800 and 600 r. 20% of the animals exposed to 400 r survived with DTS protection, but all the controls died. All the protected animals exposed to 300 r survived, but only 40% of the controls. (J.S.R.)

**17840** X-RAY INDUCED METHAHEMOGLOBIN FORMATION IN HEMOLYSATES AND IN INTACT ERYTHROCYTES OF DIFFERENT CATALASE CONCENTRATION. J. P. Heiniger and H. Aebi (Universität, Bern). Helv. Chim. Acta, 46: 255-68(1963). (In German)

Radioinduced methemoglobin formation in hemolysates and in red cell suspensions of normal and acatalatic human blood was studied under various experimental conditions. The absolute amount of methemoglobin produced by a given x-ray dose depends on hemoglobin concentration, the nature of the gas phase, catalase activity of the blood sample, and the presence of catalase inhibitors (azide). Since these factors affect methemoglobin formation in hemolysates and in cell suspensions quite differently, it is assumed that compartmentation is relevant to the manifestation of radiation effects in heterogenous systems. (auth)

**17841** RADIOSENSITIVITY IN DIFFERENT STAGES OF SPERMATOGENESIS IN DROSOPHILA MELANOGASTER. Ingerid Kvelland (Norwegian Radium Hospital, Oslo). Hereditas, 48: 221-42(1962).

The male flies of various ages were irradiated with 1150- to 3200-r doses of $Co^{60}$ $\gamma$ radiation to elucidate the

relative radiosensitivity in different stages of spermatogenesis. This was evaluated by studying the sensitivity pattern for different kinds of mutations, such as visibles, sex-linked lethals, II-III translocations, and induced crossovers in males. A peak in the frequency of recessive sex-linked lethals was observed on day 5 after irradiation, while translocation frequency showed a peak on day 7. The frequency of visibles showed no peak, but the statistical calculation suggested an increase in frequency up to day 5. A period of excessive sterility was observed on days 7 and 8 or days 8 and 9 after irradiation. The first crossovers were observed on day 6 or 7, concurrently with a low fertility but prior to the minimum of fertility. The time required for spermiogenesis should be about 6 to 7 days at 25°C in adult males. It was found that the radiosensitivity of fully mature sperms (day 1) was somewhat higher than that of nearly mature sperms (day 2). With further immaturity an increasing sensitivity was observed for all effects studied up to day 5 or 6. However, if sterility is used as a measure of radiation effect, the maximum occurs on days 8 and 9. (TCO)

**17842** THE INFLUENCE OF ENVIRONMENT ON RADIATION-INDUCED MUTATIONS AFFECTING GROWTH. Erkki I. Kivi and Allen P. James (Atomic Energy of Canada Ltd., Chalk River, Ont.). Hereditas, 48: 247-63(1962).

The effect of different environmental conditions on the expression of a random sample of x-ray induced mutations affecting a quantitative character was examined using rate of cell division in a homozygous diploid strain of yeast. Contrasting environments were provided by media that differed greatly in their composition; one was fortified with peptone and yeast extract, the other was minimal and contained only chemically defined substances and only those necessary to support growth. A homothallic strain of Saccharomyces cerevisiae var. ellipsoideus was x irradiated with a dose of 8000 r, given at a dose rate of 574 r/min. Modal growth values were unaffected by x irradiation, but the mean growth value was reduced significantly in both environments. Negative mutations (decreased rates of cell division) were detected in each instance. It was found that a superior environment frequently masks the harmful effects of radioinduced mutations. Despite the general tendency toward a protective effect of a better environment, direct evidence of the converse was found in some instances; the detrimental effects of some mutations were more pronounced in a good than in a poor environment. This suggests that a selection program performed in a superior environment may easily lead to the fixing of genotypes that will be inferior under less optimal conditions. (TCO)

**17843** CHROMOSOMAL ABERRATIONS IN $R_1$ GENERATION INDUCED BY RADIOISOTOPE $^{32}P$ IN WHEAT. Yoshio Watanabe and Kôichirô Mukade (Tohoku National Agriculture Experiment Station, Morioka, Japan). Idengaku Zasshi, 37: 218-26(June 1962). (In English)

Chromosomal aberrations induced by soaking wheat seed in solutions of $Na_2HP^{32}O_4$ were analyzed in the $R_1$ generation. Examinations were made of spikes, spikelets, anthers, and florets in the wheat. Squashed preparations were stained for cytological observations. Chromosomal aberrations are described. (C.H.)

**17844** GROWTH RESPONSE TO $Co^{60}$ γ-IRRADIATION OF HUMAN CELL LINES CULTIVATED IN VITRO. 1. TECHNICAL CONSIDERATIONS. Kouichi Takano (National Inst. of Health, Tokyo), Yasuko Hirokawa, and Eisei Tazaki. Japan. J. Med. Sci. Biol., 14: 183-93(Aug. 1961).

The effect of $Co^{60}$ γ-irradiation on HeLa cells was quantitatively analyzed by evaluation of the dose-response based on changes in cell population. The dose-response curve 7 days after 125- to 2000-r irradiation was used as the basis of evaluation. The dose rate showed no difference in the results in the range from 2.5 to 40 r/min. There was no significant difference in cell growth with γ and x irradiation. HeLa cells, including 2 different sublines, human liver cells, and conjunctiva cells, behaved similarly in the dose-response, which fitted 1- to 2-hit curves. With HeLa cells, which survived 2000-r irradiation, a tailing appeared in the dose-response curve, suggestive of a mixed population. Selection of resistant cells by colony formation was not possible. The dose-response, on the basis of the cell population 7 days after irradiation, proved to be a reproducible and reliable way of examining the behavior to γ irradiation of human cell lines, which showed closely similar responses. (H.H.D.)

**17845** GROWTH RESPONSE TO $Co^{60}$ γ-IRRADIATION ON HUMAN CELL LINES CULTIVATED IN VITRO. II. STABLE CHANGE IN RADIORESISTANCE OF HeLa STRAIN CELLS MANIFESTED THROUGH REPEATED IRRADIATION. Kouichi Takano (National Inst. of Health, Tokyo), Yasuko Hirokawa, Masahide Asano, Yoshihiko Amenomori, and Ken'ichi Michi. Japan J. Med. Sci. Biol., 15: 19-27(Feb. 1962).

On the basis of growth characteristics and dose-response analysis, it was shown that radioresistant cell lines were derived from the HeLa strain by repeated (5 times) irradiation with 2000-r doses of $Co^{60}$ γ rays. Altered characteristics were stable through serial passages, though no marked changes were revealed in cell morphology and behavior in heterotransplantation experiments. The stock cells and their resistant progeny were compared for morphology by phase-contrast microscopy and Giemsa staining. The most obvious difference between them was cell size and shape. Their transplantability in the cheek pouch of hamsters was compared. For 1st generation transplanted cells in conditioned hamsters, the resistant line showed a little higher transplantability than the stock line after inoculation with $10^5$ cells. However, their transplantability in the 2nd generation was nil, while that of the stock line was 44%. On the other hand, the transplantability in unconditioned animals was almost the same between the 2 lines. Thus the resistant line seemed to be more sensitive to the tolerance reaction of the heterologous host. No clear-cut result was obtained on heterotransplantability of the resistant cells. (P.C.H.)

**17846** ULTRAVIOLET HEMOLYSIS IN HEMATOLOGIC DISORDERS. Edward Marshall and Patricia Tsang (Univ. of California, San Francisco). J. Am. Med. Assoc., 184: 139-41(Apr. 13, 1963).

Marked resistance to ultraviolet-induced hemolysis was demonstrated in some hematologic diseases. Plasm factors were found to be responsible. The mechanism, clinical significance, and disease states associated with the condition are discussed. (C.H.)

**17847** ULTRAVIOLET IRRADIATION OF NATIVE AND DENATURED TRANSFORMING DEOXYRIBONUCLEIC ACID FROM HAEMOPHILUS INFLUENZAE. Emiliano Cabrera-Juárez and Roger M. Herriott (Johns Hopkins Univ., Baltimore). J. Bacteriol., 85: 671-5(Mar. 1963).

Two antibiotic-resistance markers in denatured deoxyribonucleic acid (DNA) from Haemophilus influenzae showed about the same sensitivity to ultraviolet irradiation as in native DNA. The resistance of markers in denatured DNA to ultraviolet (UV) light increases with

alkalinity up to pH 12. New transforming markers or genetic lethals were not produced by in vitro irradiation of either native or denatured DNA. The UV irradiation of the denatured DNA reduces its capacity to form new markers with nitrous acid. Nitrous acid reactivated some of the intrinsic marker destroyed by UV irradiation of denatured transforming DNA. (auth)

**17848** SOME EFFECTS OF IRRADIATION ON COCHLIOMYIA HOMINIVORAX. Elbert B. Dixon (Department of Agriculture, Kerrville, Tex.). J. Econ. Entomol., 55: 826-7(Dec. 1962).

Pupae 1, 29, 52, 76, and 97 hr old, were exposed to equal multiple and single doses of $Co^{60}$ irradiation varying from 600 to 7800 r. Newly emerged eggs were exposed for 1, 2, 3, and 4 min at 531 r/min and 5-hr-old eggs were exposed for 1 to 15 min to 539 r/min. Unfertilized ova and sperm were exposed to 531, 600, and 1062 r by irradiation of 8-day-old flies. Generally, multiple irradiation was more harmful to pupae than an equivalent single dose. Unfertilized eggs seemed more susceptible to radiation than newly laid eggs. Five-hr eggs appeared less susceptible than unfertilized or newly laid eggs. All newly laid eggs hatched after 1, 2, 3, or 5 min at 531 r/min. Some receiving 531 r developed into pupae, and a few of those irradiated at 1062 r developed into late second-instar larvae. All larvae of those irradiated with 1593 r or more died shortly after hatching. Injury from irradiation in the pupal stage diminished as metabolism slowed down. (H.H.D.)

**17849** PARTIAL RADIODESTRUCTIONS IN THE CHICK EMBRYO OF EARLY STAGES AND LOCALIZATION OF THE DIGESTIVE RUDIMENTS. Nicole Le Douarin (Collège de France, Paris). J. Embryol. Exptl. Morphol., 9: 1-8(Mar. 1961). (In French)

Portions of embryos were irradiated with a narrow x-ray beam, at stages bearing 9 to 25 somites, to study the development of certain organ rudiments. Only embryos surviving 7 days of incubation were examined. Transverse regions of the embryo localized behind a given somite (23rd, 15th, 6th, 4th, 2nd) were irradiated while the posterior region of the irradiated embryo was shielded to allow normal development of the allantois. The shielded anterior and posterior portions of the embryo always became connected by a pedicule of tissue; and sometimes a celosomic condition resulted. If the embryos were irradiated behind the 4th or 6th somite, some internal organs were often lodged in a pocket situated at the base of the neck. Destruction of the specific regions permitted localization of rudiments of different parts of the digestive tract and respiratory system. In additional experiments utilizing higher doses, irradiation of a narrow transverse zone (between the 6th and the 15th somites) produced embryos in which the part of the digestive tract corresponding to the irradiated region was present but anomalous. Also, embryos subjected to unilateral irradiation possessed a completely continuous intestine with a reduced diameter. Thus some repair of x-ray lesions is possible when the irradiated zone is limited in extent. (H.H.D.)

**17850** INDIRECT DISTURBANCES IN CARDIOVASCULAR ORGANOGENESIS CAUSED BY X-RAY DESTRUCTION OF REGIONS SITUATED BEHIND THE HEART RUDIMENT. Nicole Le Douarin (Collège de France, Paris). J. Embryol. Exptl. Morphol., 9: 446-55(Sept. 1961). (In French)

X-ray destruction of wide transverse strips situated behind the heart rudiment in chick embryos at 9- to 22-somite stages resulted in cardiovascular malformations. Embryos surviving at least to the 7th day of incubation were studied by injecting the arterial system with India ink and cutting the heart transversely at different levels. Malformations were more frequent and serious the closer the anterior margin of the irradiated strip approached the heart and the more extensive the destroyed region. Arterial anomalies affected mainly the brachiocephalic trunks, and, less frequently, the arch of the aorta. Disturbances of morphogenetic movements, especially of the rotation of the arterial bulbus, occurred in the development of the heart itself. The partitioning of the heart was affected in places: the pulmo-aortic septum of the bulb failed to form or remained incomplete, and the interventricular foramen did not close. The heart, therefore, in some respects maintained the organization it had at an earlier stage. In contrast, the interarterial and interventricular septa developed normally. (H.H.D.)

**17851** THE ANTIGENICITY OF $\gamma$-IRRADIATED VACCINIA VIRUS. Colin Kaplan (Lister Inst. of Preventive Medicine, Elstree, Hertfordshire, Eng.). J. Hyg., 58: 391-8(Dec. 1960).

Suspensions and purified dried virus with an initial titer of $4.1 \times 10^8$ pock-forming units/ml were irradiated in a $Co^{60}$ source at dose rates varying from 0.4 Mrad/hr at 45°C to 0.108 Mrad/hr at 15°. Suspensions were completely inactivated by 0.6-0.8 Mrad and retained measurable immunogenicity. Judged by antibody and tissue response to challenge in immunized animals, the immunogenicity of the inactivated preparations was not closely related to the inactivating dose of $\gamma$ rays. This may be associated with the fact that inactivation of suspensions occurred via both direct and indirect effects. In the dried vaccine preparations indirect radiation effects were probably negligible. Also in dried virus, inactivation of infectivity followed first-order (or pseudo first-order) kinetics until the proportion of survivors was very small. It is suggested that the likeliest explanation of survival is that the virus is heterogeneous in its response to ionizing radiations as it is to heat, ultraviolet irradiation, and $\beta$-propiolactone, as previously shown. It was concluded that the resistant fraction of vaccinia virus may be an expression of the heterogeneity of biological material in general. (P.C.H.)

**17852** METABOLISM OF GLYCOGEN IN THE SKIN AND THE EFFECT OF X RAYS. Kenji Adachi (Univ. of Chicago). J. Invest. Dermatol., 37: 381-95(Nov. 1961).

A method for isolating highly purified glycogen from dog skin is described. After perfusion of surviving isolated dog skin with $C^{14}$-labeled glucose, pure radioactive glycogen was recovered. De novo biosynthesis of glycogen in the skin was demonstrated and shown to be a rapid and continuous process. Attempts were made to follow changes in $C^{14}$-glucose uptake into glycogen in skin under the influence of x irradiation, which suppresses skin metabolism. The thigh of dogs was irradiated in vivo with 800 r. After 24 hr the skin flaps of both thighs, irradiated and non-irradiated, were perfused under identical conditions with blood or saline containing $C^{14}$-glucose. In all experiments the glucose uptake into glycogen was found to be significantly greater in the irradiated side. It was postulated that the effect is due to a radioinduced alteration in the relative rates of synthetic and degradative pathways. The inner thigh was irradiated in vivo with a single erythema dose. The increase of $C^{14}$-glucose uptake into glycogen started 18 hr after irradiation, reached a maximum at ~24 hr, and lasted for about 24 hr longer. It was concluded that phosphorylase activity in skin is weakened after irradiation; at the same time there is an increase of

glycogen synthetase activity. Ultraviolet irradiation with a mercury vapor lamp was found to have a similar effect to x rays, 24 hr after irradiation with a minimal erythema dose. The results show that glycogen turnover must be clearly distinguished from glycogen accumulation. (TCO)

**17853** ACUTE IRRADIATION EFFECTS ON THE ALKALINE PHOSPHATASE ACTIVITY OF THE GUINEA PIG SEBACEOUS GLAND. Amal K. Kurban, Fuad S. Farah, Philip Issa, and Najib Abu Haydar (American Univ., Beirut, Lebanon). J. Invest. Dermatol., 39: 3-6(July 1962).

Guinea pig skin was irradiated with a single 800-r dose of x rays, and histologic studies were conducted 3 hr to 13 days later. Some animals were injected intraperitoneally with 20 mg prednisolone at 12 and 1 hr preirradiation. Radio-induced changes in skin in uninjected animals consisted of a decrease in the alkaline phosphatase activity in the sebaceous glands, which was more marked in the peripheral cells, as well as disruption of the cellular walls and decrease in the size of the glands. The changes started 48 hr after irradiation, reached their peak at 96 hr, and gradually subsided by 120 hr. The changes were similar but milder in steroid-treated guinea pigs. It was apparent that corticosteroids impart some protection against irradiation to the sebaceous glands. (H.H.D.)

**17854** FRACTURES OF THE FEMORAL NECK DUE TO IRRADIATION. K. Armand Fischer (Univ. of Louisville, Ky.). J. Kentucky Med. Assoc., 60: 268-9(Mar. 1962).

Irradiation fractures of the femoral neck are frequently recognized late and treatment at this stage does not allow a good result. Early diagnosis and treatment insures a good result. Pathological studies reveal areas of osteoporosis in the femoral neck. Osteoclastic activity in the osteoporotic bone is absent, but osteoblastic activity is present always in some degree. In some patients, segmental acetabular fracture occurs secondary to osteoporosis. In these cases, any additional trauma results in necrosis of this area and fragmentation of the femoral neck. Damage from irradiation of bone appears to be based on loss of osteoclastic activity, death of bone cells, and some minor avascularity, which all result in osteoporosis. Then, stress and strain in the presence of these factors produces a stress fracture. The time of occurrence of fracture following therapy ranges from $4\frac{1}{2}$ months up to as long as 12 yr, with the majority of cases occurring within 5 yr following therapy. No one specific treatment is applicable to all the fractures. The prognosis is generally favorable, but the disability varies. (TCO)

**17855** FUNCTIONAL INTERDEPENDENCE OF GENES IN BACTERIOPHAGE T2. K. Ebisuzaki (Univ. of Michigan, Ann Arbor). J. Mol. Biol., 5: 506-10(Nov. 1962).

Results of experiments on bacteriophages show that the capacity of the cell infected with $P^{32}$-labeled phage to form some of the early proteins is strongly affected by decay of the incorporated isotope. Thus $P^{32}$-labeled T2 phage complexed with bacteria and then frozen loses its ability to make the phage-initiated enzymes, deoxycytidine 5′-phosphate hydroxymethylase and hydroxymethyldeoxycytidine 5′-phosphate kinase, at a rate of 40 to 50% of the rate of loss of infective centers. This suggests that a very large subunit of phage DNA is involved in the synthesis of the enzymes. The fact that the enzyme-forming capacity declined at about 40 to 50% of the rate of infective centers was interpreted as follows. In T2 phage, there are possibly 2 (or 3) functional systems and the loss of infective centers could result from inactivation of any of these functional systems, whereas the loss of enzyme-forming capacity may be due to the inactivation of only 1 of the functional systems. Furthermore, this idea presupposes an all-or-none inactivation of a functional system. This interpretation is compatible with the previous observation that the genetic markers of T2 and T4 phages are located on 1 continuous genetic map. If the genes for the early enzymes also are on this continuous map, 2 (or 3) segments corresponding to the functional systems may be visualized. (TCO)

**17856** CONGENITAL HYPOTHYROIDISM IN INFANT FOLLOWING MATERNAL $I^{131}$ THERAPY: WITH A REVIEW OF HAZARDS OF ENVIRONMENTAL RADIOISOTOPE CONTAMINATION. William D. Fisher, Mary L. Voorhess, and Lytt I. Gardner (State Univ. of New York, Syracuse). J. Pediat., 62: 132-46(Jan. 1963).

The case history is cited of an infant with congenital hypothyroidism whose mother had received 14.5 mC $I^{131}$ as therapy for Graves' disease during the end of the first trimester of pregnancy. It was estimated that the fetal thyroid received around 250000 rad, contrasted with the usual estimated 10000 to 20000 rad for the thyroid of adults treated for hyperthyroidism. The infant when seen at the age of 18 months showed marked retardation in growth and in physical and mental development. The danger of $I^{131}$ therapy to women of child-bearing age is emphasized. An extensive discussion is given on the hazards of radioactive isotopes in the environment to children, the description of the fallout pattern of $Sr^{90}$ in the U. S. and the difficulties in accurately estimating its danger to children, several possible approaches to the reduction of dietary $Sr^{90}$, $I^{131}$ contamination of the environment, and the use of nonradioactive iodide to interfere with the thyroidal uptake of $I^{131}$. The case record data of 4 other infants with congenital hypothyroidism whose mothers underwent $I^{131}$ therapy during pregnancy are also cited. Recommendations are provided for avoiding radiation injury to the fetal thyroid as well as for generally lowering the fetal, infant, and maternal incorporation of radionuclides of fallout origin. (H.H.D.)

**17857** ANTIRADIATION COMPOUNDS. III. N-2-MERCAPTOETHYLPIPERAZINES. William O. Foye and Douglas H. Kay (Massachusetts Coll. of Pharmacy, Boston). J. Pharm. Sci., 51: 1098-1101(Nov. 1962).

Mercaptoamines with an additional basic group were prepared. To obtain 2-mercaptoethylamine derivatives with a 2nd basic function located 2 carbons distant from the nitrogen, several N-2-mercaptoethylpiperazines were synthesized. The procedures involved conversion of the 2-hydroxyethylpiperazines to the corresponding bromo compounds with subsequent thiolation. Both products (1-(2′-mercaptoethyl)piperazine and 1,4-bis(2′-mercaptoethyl)piperazine) were found to give some protection to mice exposed to x irradiation. 1,4-Bis(2′-mercaptoethyl)-piperazine afforded significant protection to mice at a dose of 60 mg/kg administered 30 min prior to exposure to 575 r. An increase of 65% in 30-day survival over that of the control animals was observed. 1-(2′-mercaptoethyl)piperazine, however, at 50 mg/kg provided only a 30% increase in 30-day survival, and 1-(2′-aminoethyl)-4-(2′-mercaptoethyl)piperazine provided no protection at the same drug level. None of the compounds provided any protection for mice given 800 r. (TCO)

**17858** EFFECTS OF MICROWAVES ON NORMAL TISSUES. C. A. Linke, W. Lounsberry, and V. Goldschmidt. J. Urol., 88: 303-11(Aug. 1962).

Using a standard physiotherapy microwave generator and director, large areas of necrosis were produced in the abdominal organs of rabbits exposed to this form of radiant electromagnetic energy. The animals tolerated the large areas of necrosis well. Liver parenchymal cells were more sensitive to the effects of microwaves than bile ducts and connective tissue of the portal regions. Renal tubular cells were more sensitive than kidney glomerular and stromal cells. Reflecting aluminum foil appeared to adequately shield tissues adjacent to those being exposed. (Aerospace Med., Jan. 1963).

**17859** ON HEPATIC DYE EXCRETION WITH ALTERED BROMSULPHTHALEIN METABOLISM AFTER ROENTGEN IRRADIATION. H. Wernze, H. Braun, and M. Gabor (Medizinische Universitätsklinik, Würzburg, Ger.). Klin. Wochschr., 40: 1220-1(Dec. 1, 1962).

The conjugation reaction of Bromsulfalein (BSP) with glutathione and excretion in bile as BSP mercaptide (and to a lesser extent with cysteine and glycine) was studied in irradiated animals. Rats were exposed to 1200-r whole-body doses of 180-kv x rays delivered at a rate of 60 r/min. At various subsequent intervals (6-12, 24, and 48 hr) they were injected intravenously with 10 mg/kg BSP, and excretion of the dye in bile was followed for 1 hr, at 10-min intervals. The total 60-min biliary excretion of the dye was not significantly affected 6 to 48 hr postirradiation. The values were 83, 91, and 84% (of the total amount injected) at 6 to 12, 24, and 48 hr postirradiation, compared with 83% in nonirradiated control rats. However, the conjugation rate was significantly depressed in irradiated animals, the 60-min values being 81, 81, and 70% at 6 to 12, 24, and 48 hr postirradiation, respectively, on the basis of 100% for control rats. Chromatographic studies showed that the BSP-glutathione conjugate was diminished in bile of irradiated rats but that the cysteine and glycine fractions were not affected. Experiments with liver homogenates of irradiated rats, to which reduced glutathione was added, showed a 20% decrease in ability to form BSP mercaptide. It was concluded that the enzyme system promoting conjugation is injured by radiation. However, the possibility that the transport and excretion mechanisms for free and conjugated BSP are also injured cannot be eliminated. (TCO)

**17860** THE HISTOPHYSIOLOGY OF THE ANTIBODY RESPONSE. II. ANTIBODY RESPONSES AND SPLENIC PLASMA CELL REACTIONS IN SUBLETHALLY X-IRRADIATED RABBITS. F. J. Keuning, J. van der Meer, P. Nieuwenhuis, and P. Oudendijk (Rijksuniversiteit, Groningen, Netherlands). Lab. Invest., 12: 156-70(Feb. 1963).

Rabbits were given 500 r whole-body x irradiation at various times before or after intravenously administered paratyphoid-B H-antigen. Markedly depressed antibody responses were observed in the animals irradiated 12 or 24 hr before antigen administration; a characteristic lengthening of the induction period was seen in these cases. Essentially unimpaired antibody responses were found in the animals irradiated 12 hr after, immediately after, or immediately before antigen administration; here only a very slight initial depression was found and the peak titers even rose to above normal levels. Histologically, the splenic lymphoid tissue showed a characteristic pattern of radiation damage: the lymphoid follicles degenerated immediately and completely but the periarteriolar lymphocyte sheaths essentially survived the irradiation. (P.C.H.)

**17861** REGENERATION OF BONE MARROW IN IRRADIATED PARABIONT RATS. S. Warren and E.-M. Farrington (New England Deaconess Hospital, Boston). Lab. Invest., 12: 193-8(Feb. 1963). (TID-16740)

Castrate male rats, placed in parabiosis with castrate females, were given supralethal doses of whole-body x irradiation. The nonirradiated female partner aided survival from acute radiation sickness and eventual functional recovery of the irradiated male's own bone marrow. Appearance of female drumstick leukocytes, in numbers too great to be attributed to chance, in the peripheral circulation of the irradiated males, suggests transient support by the female. However, female cells were found only rarely and transiently in regenerated bone marrow of the males. At this dose range, marrow regeneration occurs from autogenous, persisting, hematopoietic cells. (P.C.H.)

**17862** AGE AT EXPOSURE AND THE ACCELERATION OF INTERCAPILLARY GLOMERULOSCLEROSIS IN MICE. Paul H. Guttman and Henry I. Kohn (Univ. of California, San Francisco). Lab. Invest., 12: 250-6(Feb. 1963).

A marked acceleration of progressive intercapillary glomerulosclerosis (IGS) was observed in mice irradiated shortly before and after birth. The effect was diminished when they were irradiated at 12 to 53 days of age. In both, however, the effect of irradiation was more marked and renal changes occurred earlier than in similarly treated older mice. The degree of glomerular injury was dependent on the dose. (P.C.H.)

**17863** EFFECT OF MICROWAVES EMITTED BY A RADAR POST ON CATARACT FORMATION. W. Pol. Lekarz Wojskowy, 38: 318-27(1962). (In Polish)

A review is presented on changes in the crystalline lens following microwave irradiation. The results show that short microwaves cause opacities on the anterior lens surface, and long microwaves on the posterior surface. Appearance of the opacities is favored by the presence of diabetes and by the decrease of lens enzymes following irradiation. (Aerospace Med., Jan. 1963).

**17864** THE ACTION OF ROENTGEN RADIATION ON THE GLUTATHIONE CONTENT OF THE LENS. O. Hockwin and H. D. Bergeder (Universitäts-Augenklinik and Institut für Experimentelle Ophthalmologie, Bonn). Med. Exptl., 7: 212-16(1962). (In German)

Lenses were obtained from pig, calf, and cow 2 hr after slaughter and irradiated with 150-kv x rays for 30 min at a rate of 3000 r/min, giving a total dose of 90 kr. Irradiation was conducted in a nutrient solution saturated with air. Immediate estimation of glutathione content showed a decrease in all 3 cases: 13.3% in pig lens, 10.9% in calf lens, and 4.5% in cow lens. When aqueous solutions of glutathione at various concentrations were irradiated with 90 r, 40 to 50% of the glutathione was destroyed. The destruction rate was relatively independent of the initial concentration. Hence, the rate of destruction in solution is about 4 times that in the lens. (H.H.D.)

**17865** HOMO-AUTOPLASTIC SURGERY IN BURNS OF IRRADIATED ANIMALS. A. Kh. Khaydarov, S. M. Galayko, S. I. Levin, and A. Ya. Foygel'man. Med. Zh. Uzbekistana, No. 8, 55-7(1962).

Twenty-six rabbits of about the same weight and age were subjected to charring burns on their backs (9 $cm^2$). The necrotic scab was removed at regular time intervals and an auto- or homograft was immediately transplanted into the opened wound. Twenty rabbits were subjected to

repeated x irradiation (2 × 600 r). Penetrating radiation affected the recipient of the homograft, which, when transplanted during the height of radiation sickness dissolved rapidly. The healing process of autografts was slower in the irradiated animals than in the controls. Homografts transplanted from irradiated animals, 7 days after irradiation with 600 r, to healthy animals, remained alive for a long time and the epithelization of the wound occurred after 4 to 5 weeks. (OTS)

**17866** RADIATION EFFECTS ON IMMUNE MECHANISMS. Richard D. Stoner and William M. Hale (Brookhaven National Lab., Upton, N. Y. and Univ. of Tennessee, Memphis). N. Y. State J. Med., 63: 691-8(Mar. 1, 1963). (BNL-6509)

Experiments were performed on pathogen-free Swiss albino mice to determine the repressive effect of ionizing radiation on immune mechanisms. In animals given sublethal doses of $Co^{60}$ gamma radiation by acute short-term exposure or by chronic long-term exposure at a low dose rate, ability to produce antibody was inhibited or abolished, and natural resistance and active and passive immunity to pneumococcal and Trichinella infections were severely depressed. It appears that the repression resulted from damage to the cellular defensive mechanisms of the host. Active immunity and natural resistance to influenza virus infections were not altered significantly by radiation. Exposure to radiation enhanced the severity of anaphylactic shock markedly in mice previously sensitized to tetanus toxoid and challenged with tetanus toxoid after radiation. Chronic exposure to radiation caused immediate increased sensitivity to fatal anaphylaxis. (auth)

**17867** THE EFFECT OF WHOLE-BODY IRRADIATION ON THE METABOLISM OF RAT LIVER. H. Wrba and E. Boquoi (Universität, Munich). Naturwissenschaften, 50: 97(1963). (In German)

Rats of both sexes were exposed to 800 r of whole-body irradiation. Six, 12, 24, and 48 hrs after irradiation each animal received an intraperitoneal injection of 10 μc $CP^{32}O_4$ in aqueous solution. 24 hrs later the animals were sacrificed, and 1 g of liver was dried, ashed, and measured. No significant variation was found for the 6-hr group. The maximum deviation was found for the 12-hr group with 28% increase of incorporated phosphate. Incorporation was almost as high for the 24-hr group. In the 48-hr group the deviation decreased to a 16% rise. (J.S.R.)

**17868** THE INFLUENCE OF POSTIRRADIATIVE HETEROTRANSPLANTATION OF THE HYPOTETRAPLOID AND HYPERDIPLOID VARIANTS OF EHRLICH'S ASCITES TUMOR ON SURVIVAL OF IRRADIATED RATS. M. Klímek (Biophysical Inst., Czechoslovak Academy of Sciences, Brno). Neoplasma, 8: 253-63(1961). (In English)

Heterotransplantation of the hyperdiploid Ehrlich ascites tumor (E/Dipl) and of hypotetraploid Ehrlich ascites tumor (E/Sto) was carried out in rats previously subjected to whole-body x irradiation with 720 r ($LD_{50/32}$). With an equal number of inoculated cells the time of survival in irradiated rats was shortened by the E/Sto tumor to a far greater extent (average survival time 5 days) than by the E/Dipl tumor (average survival time 13 days). Implantation of tumor E/Dipl cells, injured by repeated freezing and thawing combined with osmotic shock, caused almost the same shortening of survival time as implantation of an equal number of the same nonirradiated cells. A pronounced shortening of survival time was also caused by implantation of mouse kidney homogenate. The time of survival in rats that had received lethally irradiated E/Sto cells was shortened to a far greater extent than that of rats that had received E/Dipl cells irradiated in the same manner. The rapid death of rats after injection of tumor cells killed by repeated freezing and thawing in combination with osmotic shock, or after injection of homogenate of mouse kidney, may be explained by the action of enzymes liberated from the tissues. Differences in the effect of the 2 tumors on survival time are probably due to their immunogenetic variability. (TCO)

**17869** MENINGIOMA INDUCED BY THORIUM DIOXIDE. Robert H. Kyle, Albert Oler, Elliott C. Lasser, and Hubert L. Rosomoff (Univ. of Pittsburgh). New Engl. J. Med., 268: 80-2(Jan. 10, 1963).

A case of a degenerated meningothelial meningioma is described that became manifest 24 hr following thorium dioxide (Thorotrast) ventriculography. It meets the criteria for a tumor induced by this contrast medium. Three criteria are proposed for the establishment of causal relation: particles must be found in the immediate vicinity of the tumor; the latent period between the initial injection and the development of the tumor must be appropriate (10 to 35 yr); and the radiation dose must be considered high enough to induce neoplasia. Examination of the surgically removed tumor revealed a large number of cells containing pleomorphic hyperchromatic nuclei. Macrophages laden with thorium dioxide particles were also seen. Brain biopsy likewise revealed large macrophages filled with this substance in the subarachnoid space. A portion of the tumor subjected to alpha counting yielded 1 disintegration every $2\frac{1}{2}$ min, and liquid-emulsion radioautography demonstrated the presence of alpha-radiation tracts within the tumor. Spectrographic examination of the ashed tumor positively identified the foreign material as thorium. (H.H.D.)

**17870** MALFORMATION IN MOUSE EMBRYOS OBSERVED IN IRRADIATED PREGNANT MOTHERS. G. Itagaki. Nippon Idengaku Zasshi, 37: 70-7(Feb. 1962). (In Japanese)

Pregnant mice of B72 strain from crosses with Swiss albino males received x irradiation at a dose of 200 r through a whole-body exposure, at various days ranging from 0.5 to 15.5 days of gestation. The effects of x rays on embryos were examined at varying days of gestation. A number of malformations was observed in embryos irradiated at 8.5 to 12.5 days of gestation. A frequency in total of abnormal embryos was found to be 27.7%. The abnormalities observed were anophthalmia, exencephalia, short snout, syndactylia, polydactylia, deformed tail, short tail, and malformed arms. An average number of litters was observed to be 5.1 for 32 irradiated mothers, and 6.0 for 5 non-irradiated ones. No remarkable difference of litter size occurs between irradiated and non-irradiated mothers. In a total of 166 embryos derived from irradiated mice, 88 were male and the remaining were female. There was no marked deviation of sex-ratio in embryos derived from irradiated embryos. An average weight of embryos derived from mothers which received irradiation at 8.5 to 12.5 days of gestation was considerably lower than that of control embryos. The minimum weight was found in the embryos irradiated on the 11.5th to 12.5th day. Body-length/tail ratio was between 2.1 and 2.5 in control embryos, while that of embryos from mothers irradiated at 8.5 to 12.5 days of gestation was generally over 2.5, due to short tail. (auth)

**17871** STUDY OF SERUM AGGLUTININS AGAINST A BACTERIAL ANTIGEN IN HEMATOLOGIC RADIOCHIMERAS IMMUNIZED AGAINST THE ANTIGEN BEFORE IRRA-

DIATION. G. Mathé, J. L. Amiel, and G. Daguet (Hôpital Saint-Louis, Paris). Nouvelle Rev. Franc. Hematol., 1: 65-71(Jan.-Feb. 1961).

C57B16 mice were hyperimmunized with Salmonella typhi $R_2$ and 8 days after the last immunizing injection were x irradiated with 750 r ($LD_{100/30}$). Immediately after irradiation they were intravenously injected with $2 \times 10^7$ isologous bone marrow cells. When tested 38 days later, the serums of the mice were found to have bacterial agglutinin titers nearly as high as were found before irradiation or after a booster injection of antigen 8 days post-irradiation. In contrast, $F_1$ mice (C57B16 X DBA2), which were similarly irradiated and restored by C57B16 marrow injections, had no serum bacterial agglutinins 38 days after irradiation, irrespective of whether they received a booster injection of antigen. The results demonstrate the difference between lymphoid aplasia due to radiation and that of allogenic chimeras. In the first case the ability to respond to an antigen administered for the first time after irradiation is depressed, but immunologic memory is retained. In the second, the anamnestic potential is also lost. Thus, irradiation, while destroying the ability of antibody-forming cells to respond to an antigen, does not destroy their information of antigen specificity, which can be transmitted to isologous cells. The loss of antigenic memory in allogenic radiochimeras helps to explain their extreme susceptibility to infections to which they were immune before irradiation. (TCO)

**17872** CHANGES OF ISOELECTRIC POINTS OF SERUM GLOBULIN THROUGH ROENTGEN RAYS. Barbara Uebel (Humboldt Universität, Berlin). Nucl. Hematol., 2: VII-IX(Mar.-May 1963). (In German)

The isoelectric point (IEP) of cattle serum globulin was displaced by the action of 100-kv x radiation to the acid side. The amount of the IEP displacement is dependent on the prevailing pH of the solution during irradiation and increases in the region between pH 3 and 11 with increasing pH. Proceeding from the folded-cylinder models of Segal et al., it was assumed that this IEP change is caused chiefly by disturbance of intramolecular bonds between the side chains of the amino acids. H-bonds may be disturbed only to a small extent. Reference is made to possible biological effects. (tr-auth)

**17873** THE TUMOR PATHOLOGY OF THOROTRAST IN MAN (REVIEW OF THE LITERATURE AND NEW STATISTICAL DATA). A. Batzenschlager, M. Dorner, M. Weill-Bousson (Institut d'Anatomie Pathologique, Strasbourg). Oncologia, 28-63(1963). (In French)

An original survey of 22 new cases as well as an extensive review of previously published cases confirmed the carcinogenic action of Thorotrast. In 5 of these cases a primary carcinoma of the liver or biliary tract was present, 3 epitheliomas and 2 endothelial sarcomas. This is clearly a much higher level of hepatic carcinoma than in the general male population (2%) or in males with hepatic cirrhosis (9.5% incidence). Thorotrast is taken up mainly by reticuloendothelial cells, so that experimental tumors resulting from injection of colloidal $ThO_2$ are almost entirely sarcomas. In man, the radiation from $ThO_2$ deposits may act directly in the malignant transformation of glandular or epithelial cells; on the other hand it may induce neoplasia secondarily from a toxic effect or sclerotic action of a foreign body. However, the relative rarity of liver sarcomas in the absence of a history of exposure to Thorotrast suggests a direct effect of $ThO_2$ radiation in the carcinogenesis of these tumors. Nevertheless, the possibility that it acts as a cocarginogen cannot be ruled out at this time. 100 references are cited. (TCO)

**17874** EFFECTS OF IONIZING RADIATION ON THE HUMAN EMBRYO AND FETUS. M. Maqsood (Michigan State Univ., East Lansing). Pakistan J. Health, 10: 218-22(Jan. 1961).

**17875** EXPERIMENTAL STUDY OF THE MODIFICATIONS OF THE SERUM ALDOLASE ACTIVITY FROM X AND GAMMA RADIATIONS WITH AND WITHOUT USE OF GRAFTS. G. Nalbone, S. Totaro, A. Laconi, and F. Caffarelli (Università, Palermo, Italy). Radiol. Pract., 11: 395-405(July-Aug., 1961). (In Italian)

The variations of the aldolase activity of the blood serum of rabbits whole-body irradiated with x rays at standard voltages and with $Co^{60}$ gamma rays were studied with and without grafts. It was shown that the aldolase activity is modified both by x rays and by gamma rays. However, with equality of irradiation dose given in one exposure and with open field, the enzymatic values resulting from the x irradiation are higher than those from the gamma irradiation. The morphological behavior of the two curves is also different. The interposition of grates causes quantitative modifications of the aldolase activity in both groups of rabbits. In the group exposed to x radiation, the aldolase activity is lower than that of animals irradiated with open field. On the contrary, for the animals exposed to gamma radiation, the use of the grate produces a higher value for enzymatic activity of the blood serum than with the open field. An interpretation of the experimental results is presented. (tr-auth)

**17876** STUDIES OF METASTATIC BONE LESIONS WITH STRONTIUM 85. David M. Skiaroff and N. David Charkes (Albert Einstein Medical Center, Philadelphia). Radiology, 80: 270-2(Feb. 1963).

Case studies are presented that demonstrate the use of $Sr^{85}$ and photoscanning in the localization of metastatic bone lesions before any changes were evident in roentgenograms. It is pointed out that bone decalcification must reach about 50% before it is evident on x-ray film. Strontium-85 is shown to be well suited for photoscanning since a single $\gamma$ photon of 0.51 Mev is emitted during its decay by electron capture to stable $Rb^{85}$. The material was administered intravenously, 50 $\mu$c to adults and 20 $\mu$c to patients under 20 years of age. The estimated total-body dose to a standard man is 0.325 rads and the bone dose is 2.28 rads. (C.H.)

**17877** A CRITICAL SURVEY OF RADIATION DOSIMETERS FOR IN-VIVO DOSIMETRY DURING CLINICAL EXPERIMENTAL RADIOTHERAPY. Bernard Roswit, Stanley J. Malsky, Cyprian B. Reid, Charles Amato, Harold Jones, and Charles Spreckels (Bronz Veterans Administration Hospital, New York). Radiology, 80: 292-4(Feb. 1963).

A systematic survey was made of existing dosimeters available for in-vivo dosimetry in living organisms during clinical and experimental radiation therapy. Criteria are presented for an ideal in-vivo dosimetry system. (C.H.)

**17878** EXPERIMENTAL STUDIES OF RELATIVE BIOLOGICAL EFFECTIVENESS OF 910-Mev ALPHA PARTICLES IN MAMMALIAN CELLS. C. C. Wang (Harvard Medical School, Boston and Massachusetts General Hospital, Boston). Radiology, 80: 304-5(Feb. 1963).

The relative biological effectiveness of 910-Mev $\alpha$ particles was found to be quite similar to that of 200-kv x rays in terms of 50% tumor take of ascites tumor in A/HeJ mice. The observations were supported by the similarity

of dose and effect under conditions of anoxia and oxygenation. It is pointed out that 910-Mev α particles can be made to travel in a pencil-like beam that gives an almost uniform distribution of radiation along its path and can be made to result in cell destruction in a predetermined, small, deep-lying structure. These mono-energetic heavy particles have a uniform and well-defined range of penetration, and produce maximum ionization just before stopping in tissues, producing the so-called Bragg effect. The range of 910-Mev α particles in tissue is about 22 gm/cm$^2$. Applications of α beams in the treatment of neoplastic and neurologic diseases are discussed briefly. (C.H.)

**17879** EFFECTS OF ROENTGEN RADIATION ON GROWING BONE. RELATIVE SENSITIVITY OF EPIPHYSEAL LINE AND METAPHYSIS. Howard J. Barnhard, M. E. Davis, and George H. Kamp (Univ. of Arkansas, Little Rock). Radiology, 80: 306-8(Feb. 1963).

The relative radiation sensitivities of the epiphyseal line and metaphysis of the ulna and radius of growing dogs were compared after exposure to single doses of 800 or 1,500 r x radiation. Roentgen findings on experimental and control animals are compared. In all studies the higher the dose of radiation the earlier and more marked were the changes, and the more persistent were the residua. (C.H.)

**17880** THE USE OF METHYLCHOLANTHRENE-INDUCED SKIN CARCINOMA OF THE MOUSE IN RADIOBIOLOGY. John C. Evans (Yeshiva Univ., New York). Radiology, 80: 309-11(Feb. 1963).

Preliminary data are presented on a system for correlation of radiation control of methylcholanthrene-induced skin cancer of the mouse with studied of human cancer cells irradiated in culture. These induced squamous cancers have a more normal tumor-host relationship than tumor grafts, and should be a useful test object in the study of other biological problems related to clinical radiotherapy. (auth)

**17881** MALIGNANT INTRACRANIAL NEOPLASMS FOLLOWING RADIATION THERAPY FOR ACROMEGALY. Minnie B. Goldberg, Glenn E. Sheline, and Nathan Malamud (Univ. of California, San Francisco). Radiology, 80: 465-70(Mar. 1963).

In a review of 104 acromegalic patients, 75 of whom received roentgen therapy, 4 instances of malignant intracranial disease was found. In each case the neoplasma developed ten to thirty years after radiation therapy. One was an undifferentiated carcinoma, the second was a hemangioendothelioma, and the other two were fibrosarcomas. The possible causative roles of acromegaly and irradiation are considered. (auth)

**17882** THE LEUKOCYTOPENIC EFFECT OF FOCAL SPLENIC X-IRRADIATION IN LEUKEMIC PATIENTS. Johan G. Li (Univ. of California, San Francisco and U. S. Public Health Service Hospital, San Francisco). Radiology, 80: 471-6(Mar. 1963).

Radiation directed to the spleen is known to reduce the circulating leukocytes in leukemic patients. For further investigation of this phenomenon, 7 patients with chronic leukemia were given infusions of plasma obtained before and after they had received radiation to the spleen. Administration of the control plasma, as expected, did not lower the leukocyte count; in 2 instances it appeared to initiate a progressive increase in the leukocyte level, which continued for several weeks before a plateau was reached. In all but one study, infusion of experimental plasma resulted in a statistically significant decrease in the number of leukocytes. This effect was detectable twelve hours after the infusion, reached a maximum in thirty-six hours, and was dissipated by the fourth day. It is postulated that a humoral factor liberated by the spleen in response to x irradiation caused this decrease, although the underlying mechanism is unknown. (auth)

**17883** PHOTOCONDUCTANCE CRYSTALS FOR THE RAPID SURVEY OF RADIUM AND RADOM SOURCES. Emanual G. Tulsky and Jen-ti Chen (Univ. of Pennsylvania, Philadelphia). Radiology, 80: 486-8(Mar. 1963).

An inexpensive device incorporating a cadmium sulfide photoconductance crystal is described for the quick survey of the activity of individual radon seeds prior to use and for the rapid sorting of radium needles after use. The method increases the accuracy of dosage to the patient and decreases the radiation hazard to the operator. (auth)

**17884** EXPERIENCE WITH RADIOACTIVE TANTALUM WIRE AS A SOURCE FOR INTERSTITIAL THERAPY. W. E. C. Allt and J. W. Hunt (Princess Margaret Hospital, Toronto). Radiology, 80: 581-7(Apr. 1963).

The use of $Ta^{182}$ wire in the treatment of the integument generally, and of the buccal mucosa in particular, is discussed. The characteristics and dosimetry of $Ta^{182}$ are reviewed. Results are summarized from the treatment of 126 cases of cancer of the buccal mucosa, lip, skin, and neck. (C.H.)

**17885** EVOLUTION OF THE EXPERIMENTALLY IRRADIATED HOMOPLASTIC OSSEOUS GRAFT. Pietro Patrese (Università, Padua). Radioterap., Radiobiol. Fis. Med., (3) 17: 315-31(July-Aug. 1962). (In Italian)

After a review of experiments on the effect of ionizing radiation on the osseous callus from a fracture, an experimental study on homoplastic osseous grafting in the rabbit irradiated with 280, 480, 720, 1300, and 1950 rad is reported. Observations made on histologic preparations immediately after and 15 days after irradiation show that with small doses there is a reversible damage. With higher doses, however, more severe damage occurs, accompanied by a breakdown in the defense of the host tissue. (auth)

**17886** GENETICS OF PENICILLIUM CHRYSOGENUM. IV. EFFECTS OF CERTAIN MUTAGENIC AGENTS ON SOMATIC SEGREGATION FROM HETEROZYGOUS DIPLOIDS. G. Sermonti and G. Morpurgo (Istituto Superiore di Sanità, Rome). Rend. Ist. Super. Sanita, 24: 483-93 (1961). (In Italian)

The possibility of increasing the rate of somatic segregation processes from heterozygous diploid strains of P. chrysogenum was investigated by means of mutagenic agents. Treatment with formaldehyde, ultraviolet radiation, nitrogen mustard, or x rays produced a striking increase in the rate of occurrence of somatic segregation processes. After nitrogen mustard treatment, genetically unstable clones were isolated whose conidia gave rise to colonies regularly showing segregant sectors. X irradiation of the conidia with 50000 r also produced a marked increase in somatic segregation. Ultraviolet irradiation produced a significant increase in both the number of yellow colonies and the number of colonies with yellow sectors. The mutagenic action of formaldehyde was weaker than that of the other agents. The effect of ultraviolet and x irradiation was immediate on some nuclei and delayed on others. An index of the immediate effect was the rate of occurrence of homogeneous segregant colonies and of the delayed effect of colonies showing segregant sectors of late appearance. (TCO)

**17887** ACTION OF X AND γ RAYS ON THE NERVOUS SYSTEM; IMMEDIATE EFFECTS AND EFFECTS INTERVENING AFTER A BRIEF DELAY. J. M. Posternak (Université, Geneva). Schweiz. Med. Wochschr., 92: 1177-90 (Sept. 1962). (In French)

Early responses of the nervous system to ionizing radiations are considered from the viewpoints of neuro- and psychophysiologic effects and mechanism of action of radiation at the level of the central nervous system, peripheral nervous system, and sensory receptors. (TCO)

**17888** ANTIGENIC MATERIAL: PERSISTENCE IN HYPERSENSITIVE CELLS. Robert S. Speirs (New York Univ., New York). Science, 140: 71-2(Apr. 5, 1963).

Radioactivity derived from injections of tritiated tetanus toxin was observed in lymphocytes and macrophages for as long as 9 months after injection into immunized mice. These labeled cells became highly vacuolated and attracted eosinophils and lymphocytes when the animals were reinjected with specific antigen. (auth)

**17889** HOMOLOGOUS DISEASE REACTIVATION BY X-RADIATION. Robert S. Schwartz and Lorraine Beldotti (Tufts Univ., Boston). Science, 140: 171-2(Apr. 12, 1963).

Hybrid $F_1$ mice ($BDF_1$) that failed to develop homologous disease after injection of parental (C57 Bl/6) spleen cells were treated with 400 roentgens of total-body x radiation 13 months later. Typical homologous disease promptly developed in these mice. This suggests that parental lymphoid cells may acquire immunologic tolerance to foreign host antigens and that the tolerant state is disrupted by sublethal doses of radiation. (auth)

**17890** OXIDATIVE PHOSPHORYLATION IN THE LIVER AND KIDNEY OF RATS TREATED WITH FRACTIONS OF HOMOLOGOUS HOMOGENATES OF ORGANS OF IRRADIATED ANIMALS. P. Erede, F. Duerst, and P. Bistolfi (Università, Genoa). Sperimentale, 111: 66-76 (1961).

When whole homogenates of various organs removed from rats exposed to 400- or 800-r doses of whole-body x irradiation were injected intraperitoneally in normal rats, liver and kidney mitochondria isolated from the recipient rats showed an inhibition of oxidative phosphorylation, or a diminished P/O ratio. The 400- and 800-r doses corresponded to the $LD_{50}$ and $LD_{100}$ doses in the animals. In attempts to isolate the inhibitory factor in homogenates of irradiated organs, the homogenates were fractionated by high-speed centrifugation in a sucrose density gradient into nuclear, mitochondrial, and supernatant fractions. The fractions were then injected intraperitoneally in normal rats, from which liver and kidney mitochondria were isolated and assayed for oxygen and inorganic phosphate uptake. Almost all of the inhibitory action of irradiated homogenized organs could be found in the supernatant fraction; nuclei and mitochondria showed little activity. For example, the supernatant from 250 mg (fresh weight) liver or kidney irradiated with either x ray dose reduced the P/O ratio of liver mitochondria of the recipient rats to values of 1.83 to 1.90 compared with a control value of 2.81. In kidney mitochondria the corresponding values were lowered to 1.76 to 2.06 compared with 2.89. Whole homogenates and the supernatant fraction induced swelling of liver and kidney mitochondria but this was not seen with injections of nuclear and mitochondrial fractions. (H.H.D.)

**17891** ELECTRON SKIN RESONANCE IN IRRADIATED BACTERIOPHAGES AND THEIR CONSITUENTS. PART I. Karl G. Zimmer, Wolfgang Koehnlein, Gerhart Hotz, and Adolf Mueller (Kernforschungszentrum, Karlsruhe, Ger.). Strahlentherapie, 120: 161-90(Feb. 1963). (In German)

In order to definitely ascertain that radioinduced free radicals form an important link in the chain of events leading to observable biological effects experiments of quantitative nature are required. Methods for obtaining and evaluating electron spin resonance absorption spectra quantitatively, methods for calibrating substandards in terms of concentration of free spins, and measurements of the yield of production of centers of electron spin resonance absorption by x rays of the amino acids are described. (auth)

**17892** THE INFLUENCE OF THE ENERGY SPECTRUM OF 14-Mev ELECTRONS AND THE COMPARABLE EFFECTS OF 14-Mev ELECTRONS, 14-Mv AND 200-Kv X RADIATION ON DROSOPHILA EMBRYOS. Benno Markus and Elisabeth Sticinsky (Universität, Gottingen, Ger.). Strahlentherapie, 120: 262-8(Feb. 1963). (In German)

In studies of the influence of the energy-(LET-) spectrum of fast electrons on biological reactions, a significant effect in damage rate of Drosophila embryos (age 1, 1.75, and 4 hours) with electrons of 14.2 Mev was found in all three age-classes. The effect was strongest at the age of 4 hours and here, with an ionization dose of 700 r, given in a plexiglass-phantom in a depth of 30% relative depth dose, a damage rate of 230% was produced, against 100% in a depth of 100% relative depth dose. Irradiation with 14 Mev electrons in 100% depth showed significant differences in effect for all three age-classes against 200 kv as well as against 14 Mv x-ray irradiation. With equal ionization dose, the effect of fast electrons always was less than that of x rays. The differences in efficiency showed a characteristic dependence on age. Between 200 kv and 14 Mv x rays there was no difference at the 1 hour age, but with advancing age an increasing difference in effect was observed. The results are compared with those of Fritz-Niggli and Schinz. (auth)

**17893** HISTOCHEMICAL INVESTIGATION OF THE INFLUENCE OF $Co^{60}$ GAMMA RADIATION ON SOME ENZYMES OF THE INTESTINAL WALL OF RATS AND GUINEA PIGS. Parviz M. Ansari, Heinz Eder, and Walter Naegele (Battelle-Institut e. V., Frankfurt am Main). Strahlentherapie, 120: 275-96(Feb. 1963). (In German)

A histochemical investigation was made of the influence of a 1200 rad $Co^{60}$-γ-total-body irradiation upon the β-glucuronidase, adenosine triphosphatase, cytochrome oxidase, and monoamine oxidase of the intestinal wall of rats and upon the pseudocholine esterase of the intestine of rats and guinea pigs. β-glucuronidase had a higher activity with abnormal distribution 1 hour after irradiation and activity loss in the intestinal villi and ganglion cells 48 hours after irradiation. The adenosine triphosphatase content of the intestinal villi was reduced 1 hour after irradiation but became normal later. The activity in the muscularis decreased after 1 hour and was still low after 48 hours. The cytochrome oxidase content of the intestinal villi decreased 4 hours after irradiation and increased again after 24 hours and decreased again after 48 hours. The enzyme content of the villi stroma was not influenced by irradiation. The monoamine oxidase of the intestinal villi decreased 1 hour after irradiation and after 4 hours showed a high activity in the Crypts of Lieberkuehn, which normally do not show any activity. The activity of the enzyme in the villi and in the Crypts of Lieberkuehn decreased after 48 hours. The pseudocholine esterase of the intestinal wall of rats and guinea pigs showed high activity in the Crypts of Lieberkuehn 1 hour after irradiation as well as an abnormal distribution in the villi after 1 hour

and after 24 hours (guinea pigs). Enzyme activity could not be detected after 48 hours. The functional importance of enzyme changes is discussed. (auth)

**17894** SULFUR-35 METABOLISM IN IRRADIATED GROWING BONES. Arnost Babicky and Jaromír Kolár (Inst. of Biology, Czechoslovak Academy of Sciences, Prague and Univ. of Prague). Strahlentherapie, 120: 300-7(Feb. 1963). (In German)

In investigating the reaction of the organic ingredients of bone to x rays by means of $S^{35}$ it was found that there is not only a local change but also a generalized reaction of the skeleton to the local irradiation. This generalized bone reaction was previously demonstrated using $Ca^{45}$. The reaction of the organic ingredients of the bone precedes the reaction of the inorganic ingredients (bone salts). It is a proof that a damage to the cells and of the organic bone matrix is the principal cause for the changes occurring in the irradiated bone. Therefore, the generalized reaction of the skeleton to a local radiation trauma can be considered as a biological law. (auth)

**17895** THE INFLUENCE OF IONIZING RADIATION ON THE PROTEIN SULFUR OF RADIOSENSITIVE TISSUES. PART I. Jan Neuwirt, Zdenek Pokorny and Jitka Borová (Univ. of Prague). Strahlentherapie, 120: 308-14 (Feb. 1963). (In German)

Immediately after irradiation an appearance of reserve sulfhydryl of radiosensitive protein substances occurs. This is shown by an increase in the protein sulfhydryl which was determined by the method by Benesch. The destruction of bindings which maintain the tertiary and secondary structure of protein substances leads to the stimulation of catabolic events. Part of the protein sulfur passes over into the non-protein fraction. Most of this sulfur is stored in the liver. (auth)

**17896** CONCERNING THE DEPENDENCE OF X-RAY EPILATION ON IRRADIATED VOLUME. Ludwig Rausch (Universität, Marburg, Ger.). Strahlentherapie, 120: 418-30(Mar. 1963). (In German)

The loss of hair which follows irradiation can be determined quantitatively in albino guinea pigs by counting the hair density before and after irradiation. The technique of investigation, its advantages and limits, as well as the mathematical-statistical evaluation of the results are described. With increasing dose a gradual increase in effect resulted, which is in relation to the hair cycle pattern of the guinea pig and which is distinguished by lower minima of the hair density and a retarded regrowth. Using this method it is shown that the epilation effect depends not only upon the hair bulbus dose, but also upon the size of the irradiated animal body volume. Analogies to radiation pathology of man are pointed out. Little is known with certainty about the specificity and nature of the observed factor which amplify the effect. (auth)

**17897** ECONOMY OF DEEP THERAPY WITH IONIZING RADIATION. Hans Ludwig Keller (Universität, Erlangen, Ger.). Strahlentherapie, 120: 431-48(Mar. 1963). (In German)

The cost-price of 1 r focal dose in deep x-ray therapy with conventional generators, with far distance radiation units of radioactive isotopes, and with particle accelerators is considered. The costs of 1 r to an extraordinary degree were found to depend on the extent of utilization of the apparatus. Costs with a constant year capacity therefore are less comparable than costs at a constant utilization of a possible year capacity. With a 40% utilization of the theoretically possible maximal capacity per year the costs of 1 r focal dose in different rays lies between approximately 5 and 15 Pfennig (about 1.25 to 3.75 cents); thus they differ approximately by the factor 3. These results are important for planning of radiation departments in regard to economy. Economical considerations of strongly filtered rays of conventional generators are discussed. Details on the economically best choice of activity in radioactive isotopes are given. Furthermore the possibilities of increasing the capacity are shown with which reduction of cost-price of 1 r focal dose is combined. Finally, data on costs of 1 r focal dose can be the basis for a fair system of tariffs. (auth)

**17898** INCIDENCE OF PULMONARY AND SKIN METASTASES IN WOMEN WITH BREAST CANCER WHO RECEIVED POSTOPERATIVE IRRADIATION. Thomas L. Dao and John Kovaric (Roswell Park Memorial Inst., Buffalo). Surgery, 52: 203-12(July 1962).

The effect of x-ray treatment (total dose of 4500 r over a 3-week period) was evaluated in 354 patients, some of whom had previously undergone mastectomy. In clinically and pathologically comparable cases, ipsilateral pulmonary metastases and skin metastases in patients who had radical mastectomy were 14 and 34%, respectively, whereas in patients who received irradiation after mastectomy, incidences of metastases at those 2 sites were 37 and 52%. A similar change of patterns of metastases in lungs and skin was also observed in patients who have had simple mastectomy and irradiation. The increase in the incidence of ipsilateral skin and pulmonary metastases is ascribed to the effect of irradiation, and the observations strongly support the postulate that irradiation favors development of metastases in the lungs. The fact that metastases developed in the skin within the portals of irradiation, and in the ipsilateral lung in the same patients, is evidence that the lymphatic and vascular obstructions due to fibrosis contribute to the development of the metastases in these tissues. The different patterns of skin and lung metastases in nonirradiated patients render additional support to the theory. The incidence of these injuries in 50 irradiated patients was: 18 had permanent disability of the upper extremities; 14 had necrosis of the bones with fractures of the clavicle and ribs; 25 had initial pneumonitis and subsequently pulmonary fibrosis; and 40 had skin changes, ranging from desquamation to ulceration. No significant difference was demonstrated in the survival of patients with cancer of the breast who received radical irradiation in addition to mastectomy. Furthermore, irradiation may favor the development of metastases in the lungs and skin, and cause disabling injuries. (TCO)

**17899** EFFECT OF IONIZING RADIATION ON THE BLOOD FORMING ORGANS. P. Reizenstein (King Gustav V Research Inst., Stockholm). Svenska Lakartidn., 58: 2335-44(Aug. 25, 1961). (In Swedish)

**17900** SUPERVOLTAGE COBALT-60 TREATMENT OF BLADDER CANCER: PALLIATION OR CURE? Leonard M. Liegner and John A. Taylor (St. Luke's Hospital, New York). Trans. Am. Assoc. Genito-Urinary Surgeons, 53: 29-36(1962).

In a series of 42 bladder cancers treated with combined transurethral resection and external supervoltage $Co^{60}$ irradiation, 37% survived 3 yr or longer irrespective of stage and grade. The total calculated tumor dose of the bladder varied from just under 6000 r in 10 patients to 6000 r in 30 patients, and to over 6000 r in 2 additional patients. The overall time of treatment was 6 weeks. The delivery of a cancerocidal dose to the bladder was accom-

panied by increased urinary and bowel symptoms. Of 42 patients, 32 had pre-existing hematuria, and in 25 of the 32 this was the sole symptom. Thirteen other patients had multiple symptoms of urgency, frequency, dysuria, and nocturia. In 7 patients there was no aggravation of pre-existing symptoms; in 31, symptoms were increased. In 16 of the 31 patients with aggravated symptoms, diarrhea was associated and in 9 of the 16 patients, diarrhea preceded urinary symptoms by a 1000 to 3000-r tumor dose. The tumor dose at which urinary symptoms first appeared was as follows: 5 cases, under 2000 r; 11 cases, 2000 to 4000 r; 12 cases, 4000 to 6000 r. Following the completion of irradiation 23 patients had persistent symptoms; in 10, urinary symptoms were associated with cystoscopically verified radiation cystitis which continued 6 to 12 months beyond the course of cobalt therapy. (H.H.D.)

**17901** ACROMEGALY. John H. Lawrence, Cornelius A. Tobias, and James L. Born (Univ. of California, Berkeley). Trans. Am. Clin. Climatol. Assoc., 73: 176-84 (1961).

The dose distribution in the brain is calculated for irradiation of the pituitary of patients with acromegaly using 900-Mev alpha particles and 2-Mev x rays. In all 3 axes, but especially in the longitudinal axis, extrapituitary brain tissue receives lower radiation dosage with alpha particles than x rays. This is particularly important in order to avoid damage to optic and other cranial nerves when temporal lobes receive large doses. Successful results are reported for 16 out of 17 acromegalic patients treated with 4000 to 7200 rad alpha-particle irradiation. It is believed that with this particulate radiation, it may be possible to deliver as much as 10000 to 15000 rad to the sella region and, pending the development of hormonal or chemical means of control, such high energy therapy may lead ultimately to much better control of the symptoms and signs of acromegaly and to further extension of life. (H.H.D.)

**17902** EFFECTS OF DNA ON IRRADIATED AND NON-IRRADIATED BONE MARROW. Vestn. Cesk. Akad. Ved., No. 7, 8(1962).

The effect of DNA on mice irradiated by an average lethal dose was investigated. After irradiation, DNA from animals of the same genetic strain but different genetic tribe, (white and gray mice) or from animals of different genetic strains (calf thymus, goose, and duck erythrocytes) was injected. All the DNA's except that of calf thymus enhanced the activity of bone marrow. The degree of stimulation was not affected by the specificity of the DNA injected. All the DNA samples obtained from animals of different strains enhanced chromosome disorders. Foreign DNA damages chromosomes, which then tend to break to pieces. The increase in chromosome aberration was found both in irradiated and non-irradiated animals. It was determined that the percentage of aberration increases with the genetic distance of the animals from which the DNA was extracted. The results may contribute to the problem of cell differentiation and splitting. It is believed that this may help to find healing principles in cases where cell reproduction is damaged or out of control, such as devastating multiplication. (P.C.H.)

**17903** EFFECTS OF RADIATION ON TRANSDUCTION IN PSEUDOMONAS AERUGINOSA. B. W. Holloway, Marilyn Monk, Hynette Hodgins, and Barbara Fargie (Univ. of Melbourne). Virology, 18: 89-94(Sept. 1962).

The effects of uv and $Co^{60}$ $\gamma$ radiation on transduction in P. aeruginosa were studied. Two phages, B3 and F116, differed in their transduction response to radiation, and this difference was related to the size of the bacterial chromosomal fragment transferred by each phage, by the finding that joint transduction of the linked markers str and try occurs frequently with F116 but was not detected with B3. The frequency of the joint transduction was reduced by uv, but $\gamma$ radiation had no such effect. The stimulation of transduction frequency by $\gamma$ radiation was unexpected. On the likely assumption that a transducing particle in Pseudomonas consists of both phage and bacterial DNA, as has been shown in other systems, the stimulation by $\gamma$ rays could be the result of effects on the phage DNA. The phage DNA component may hinder the synapsis of the bacterial chromosomal fragment, and the action of the radiation may be to damage the phage DNA, thereby facilitating synapsis and increasing integration of the bacterial markers. This would be consistent with the concept that the stimulation of transduction by irradiation represents a switch from abortive transduction to complete transduction. (H.H.D.)

**17904** INFLUENCE OF X-RAY IRRADIATION ON THE METABOLISM OF LIPIDES IN THE LIVER OF A DOG. T. Y. Polosukhina, M. S. Valitova, et al. Vopr. Med. Khim., 8: No. 2, 192-9(1962).

The serum of venous blood showed an increased concentration of neutral fats, phosphor lipids, and cholesterol the third day after a single irradiation of the dog with an x-ray dose of 500 r. An increase in the concentration of ketones in the blood in the case of radiation sickness was caused by the formation of ketones in the liver. The content of glycogens in the liver tissue decreased, while the content of neutral fats and cholesterol increased. (OTS)

**17905** EXPERIMENTAL RESULTS FROM THE COMBINED ADMINISTRATION OF DEHYDROASCORBIC ACID AND IONIZING RADIATION ON YOSHIDA SARCOMA IN RATS. E. Fleischmann and Z. Deanovic (Universität, Vienna). Z. Krebsforsch., 64: 488-9(1962).

Attempts were made to determine whether dehydroascorbic acid (DHAA) and radiation have additive effects by in vivo experiments with Yoshida sarcoma in rats. The rats were injected with 45000 tumor cells subcutaneously, and 7 days later were injected with 2 mg/kg DHAA intraperitoneally. Some animals were x irradiated on the 8th, 10th, and 13th days after tumor implantation with 300-r daily doses. An additive effect of DHAA and x rays on the inhibition of tumor growth was demonstrable. The average tumor weight on the 16th day after implantation in the 4 groups of rats (control, injected, irradiated, injected-irradiated animals) was as follows: 15.56, 14.00, 9.91, and 7.23 g, respectively. (TCO)

**17906** ON THE PATHOGENESIS AND THERAPY OF HYDRONEPHROSIS OCCURRING AFTER RADIOTHERAPY OF GENITAL CARCINOMA. H. Klosterhalfen. Z. Urol., 53: 693-700(Dec. 1960).

**17907** THE a$\alpha$ EFFECT, A CORRELATION BETWEEN THE MATING TYPE CONSTITUTION AND RADIATION RESISTANCE OF YEAST. Wolfgang Laskowski (Freie Universität, Berlin). Zentr. Bakteriol. Parasitenk., Abt. I. Orig., 184: 251-8(Jan. 1962).

The sensitivity to x rays and Po $\alpha$ rays of diploid strains of Saccharomyces, with mating type alleles of identical genotype (isogenic), was investigated in relation to the combinations of the alleles aa, $\alpha\alpha$, and a$\alpha$. The results showed that the a$\alpha$ strain was more radioresistant than the 2 homozygous strains aa and $\alpha\alpha$, which showed similar radioresistance. The relative resistance of a$\alpha$ cells, referred to as the a$\alpha$ effect, is superimposed on

other genetically conditioned resistance differences. For example, the radioresistant strain was more dependent upon the presence of serine and valine-isoleucine for growth than the homozygous, less resistant strains. In contrast to the observed sensitivity to x rays and $\alpha$ particles, the uv sensitivity of heterozygous and homozygous diploid strains of the yeast was the same. Since the a$\alpha$ strain was previously shown to have 1.2 to 1.5 times as much catalase activity as aa or a$\alpha$ strains, it is suggested that the radioresistance of this strain may be due to its enhanced ability to deal with the $H_2O_2$ or other peroxides which are formed in the primary radiation reaction. In this way, secondary reactions of peroxides with yeast cell constituents would be less apt to occur in the a$\alpha$ strain. Triploid strains of Saccharomyces showed the same sensitivity to ionizing and uv radiation, and the sensitivity could not be correlated with mating type alleles. (H.H.D.)

**17908** REMOTE SEQUELAE OF CHANGES IN THE REACTIVITY OF THE CEREBRAL CORTEX IN MONKEYS SUBJECTED TO IONIZING RADIATION. Sh. L. Dzhalagoniya. Zh. Vysshei Nervnoi Deyatel'nosti im. I. P. Pavlova, 12: No. 4, 623-9(1962).

Steady conditioned reflexes were developed in five monkeys prior to whole-body single x irradiation with 378 to 399 r. One year later the monkeys had recovered from a moderate radiation sickness and the conditioned reflexes had also completely recovered. Subjection of the animals to various conditions of stress brought about the development of severe neurosis, which did not occur under similar conditions before the irradiation. The vulnerable cortex is regarded as a residual consequence of the radiation sickness to which the animals had been subjected. The phenomenon of the reactivity of the cerebral cortex after recovery from radiation injury may serve as a pathogenic factor for the experimental development of neuroses in monkeys. (OTS)

**17909** CHANGES IN THE DENSITY OF BLOOD SERUM AFTER WHOLE-BODY RADIATION. Z. Dienstbier and M. Rakovič (Charles Univ., Prague). p.92-4 of "Probleme und Ergebnisse aus Biophysik und Strahlenbiologie III." Berlin, Akademie Verlag, 1962. (In German)

Whole-body irradiation of rats with 600-r doses of 200-kv x rays resulted in a rise in serum density 6 hr later. The density rose to 1.0273 from a control value of 1.0244. Only slight increases in serum density occurred in rats with skin burns or in rats deprived of water for 48 hr. The radioinduced rise in serum density was more pronounced when the serum was incubated at 4°C for 24 hr after collection of the blood. The peak rise in serum density was noted 6 hr after irradiation, but elevated values were also seen at 4, 8, 12, 24, and 48 hr postirradiation. Since the other forms of stress did not elevate serum density, the effect of irradiation on the density appears to be a direct and specific one. It is suggested that some tissue constituent, possibly DNA, is broken down during irradiation and released into the blood, causing a rise in serum density. (H.H.D.)

**17910** THE PRODUCTION OF SUBSTANCES WITH HIGH INACTIVATION AND WITH A PROTECTIVE EFFECT AGAINST DIRECT IRRADIATION IN AGAR BY X-RAYS, ALPHA RAYS AND ULTRAVIOLET LIGHT. Heinz-Erhardt Magnus. Thesis, Karlsruhe, Ger., Universität, 1962. 55p. $2.00; 8 DM.

Irradiation of agar by x rays, alpha rays, or ultraviolet light produces inactivation substances in the agar. This can be demonstrated by culturing bacteria e.g., B. Coli. The mean life time of these substances has a value between 7 and 20 sec. They are produced by at least two elementary processes. The substances produced by x rays have a molecular weight that is smaller than 200. Alpha-ray produced substances inactivate at least by a factor of 30 more than x-ray produced substances. Irradiation of B. Coli cultured on previously irradiated agar results in an antagonism between the direct irradiation and the substances in the agar. A protective action takes place only when the substances produced in the agar have diffused into the B. Coli cells before the direct irradiation. They have a protective effect only for a limited time of 30–60 sec. (Gmelin Inst)

**17911** THE MORTALITY OF MOUSE EMBRYOS AFTER WHOLE-BODY X IRRADIATION WITH 200 r IN THE PREIMPLANTATION PERIOD. Dietrich Egner. Thesis, Berlin, Freie Universität, 1961. 26p. $2.00; 8 DM.

One hundred twelve white mice were exposed to whole-body x irradiation with 200 r during the preimplantation period. Prenatal mortalities of the embryos of 62 and 14 percent were observed for the irradiated animals and the controls respectively. The explanations for this high mortality are given. (Gmelin Inst)

**17912** CYTOGENIC RADIOSENSITIVITY OF SEXUAL CELLS OF MONKEYS AND MICE AT THE LEVEL OF LOW AND OTHER DOSES. M. A. Arsen'yeva, G. G. Tinyakov, An-ch'ih Wang, Hsiu-ch'uang Ma, and Chun-shu Chang. p.50-62 of "Radiatsionnyi Genetika." Moscow, Publishing House of the Academy of Sciences, 1962.

Males of Macaca mulatta and of white mice were subjected to a single exposure of x rays (doses of 10, 50, 100, 200, 400, and 600 r, dosage rate 6.3 r/min) and gamma rays (doses of 10 and 50 r). On the 10th, 20th, 30th, and 50th day after irradiation (I), cyto- and histological analyses were made of the testes, as well as determinations of the frequency of chromosomal rearrangements (CR) in the anaphase and telophase of first mitotic division of cells of the germinal epithelium. Frequency of CR increased with increasing dose of I. The number of CR per 1 r, on the 10th day after I was 2 times greater in monkeys than in mice (0.115 and 0.057%, respectively), and remained constant with all of the doses employed. Temporary sterility developed in monkeys on the 30th day after I with a dose of 100 r; in mice on the 20th day, with a dose of 400 r. It was concluded that monkeys are 2 to $2\frac{1}{2}$ times more radiosensitive than mice (the assumed doubling dose is of 3.8 and 9.3 r, respectively). (OTS)

## Radiation Sickness

*Refer also to abstract 18369.*

**17913** PROPHYLAXIS AND TREATMENT OF LEUKOPENIAS DUE TO IONIZING RADIATIONS. Carlos Leuje Casanueva. Acta Iberica Radiol.-Cancerol., 15: 315-23(Oct.-Dec. 1960). (In Spanish)

**17914** OCCUPATIONAL LESIONS FROM CHRONIC IRRADIATION OF WORKERS WITH RADIUM AND STRONTIUM-90. A. David, J. Mueller, and M. Rejsková (Charles Univ., Prague). Acta Univ. Carolinae, Med., Suppl., 14: 207-18(1961). (In Czech)

Clinical and hematologic studies were conducted on 103 subjects who worked with luminescent radioactive substances. The study was prompted by the discovery of acute radium dermatitis of the fingers of some workers who had been applying luminescent paint under working conditions later shown to be unsafe. Significant hematologic abnor-

malities were found in 24 of the subjects and may be broken down as follows: reticulocytosis exceeding 1.5%, 14 cases; bone marrow hyperplasia, 10; increased mitotic activity in marrow, 4; lymphocytosis exceeding 40%, 8; leukocytosis exceeding 10000 cells/$mm^3$, 2; leukopenia below 4000 cells/$mm^3$, 3; erythrocytosis, 1; hypochromasia, 2; thrombocytopenia, 2; and chronic lymphadenoma, 1. Thus, the hematologic changes are mainly characterized by a stimulation of erythropoiesis, and are regarded as evidence of relatively low level deposition of radionuclides. The body burden of 34 subjects was assessed by estimation of urinary excretion of $Sr^{90}$. In dial painters the excretion values were 10 to 30 times higher than maintenance workers in the same factories. Microcurie levels were found in only 2 painters. In general, the prognosis of the workers was considered good because of the relatively low $Sr^{90}$ deposit. (P.C.H.)

**17915** SKIN CHANGES IN WORKERS USING RADIOACTIVE LUMINESCENT PAINT. L. Jirásek and O. Juren (Charles Univ., Prague). Acta Univ. Carolinae, Med., Suppl., 14: 219-22(1961). (In Czech)

Clinical examinations were made of 17 workers engaged in applying a luminescent paint to meter dials. The paint (Lumostabil) contained the $\beta$ emitters $Sr^{90}$ and $Y^{90}$, and the operation was being carried out without sufficient precautions. Dermatitis of a subacute type was noted in 13 workers and the lesions differed from the acute and chronic dermatitis resulting from $\gamma$ emitters or x rays. The local changes included eponychia, telangiectasia, atrophy, and hyperhidrosis and in some cases subjective symptoms were also present. Most of the changes were reversible and disappeared after further exposure was avoided. It was considered that the skin lesions could be attributed mainly to $\beta$ radiation from $Sr^{90}$ and $Y^{90}$, and to a minor extent only to $\alpha$ and $\gamma$ radiation from $Ra^{226}$ and its fission products. The paint contained 0.02 to 0.05 mg $Ra^{226}$ and 0.17 to 1.2 mC $Sr^{90}$ per g, $Y^{90}$ arising as a daughter product of $Sr^{90}$. It is believed that this is the first report of radiodermatitis occurring as a result of the use of luminescent paint. (H.H.D.)

**17916** LONG-TERM FOLLOW-UP STUDIES OF OCCUPATIONAL X-RAY AND RADIUM DERMATITIS. L. Jirásek and M. Rejsková (Charles Univ., Prague). Acta Univ. Carolinae, Med., Suppl., 14: 223-8(1961). (In Czech)

Clinical findings are described as they appeared up to several decades after the original radiation exposure. Chronic progress of the skin lesions and late sequelae was observed in 137 persons some of whom incurred dermatitis from the application of luminescent paint to meter dials, but the majority from occupational exposure to roentgen radiation. Various stages of skin lesions observed were: eponychia, acrocyanosis, abnormal pigmentation, telangiectasis, hyperhidrosis, atrophy, alopecia, verrucous keratomata, erythrosis, and ulceration. Thus, the lesions encompassed degenerative as well as proliferative changes, including those of a precancerous nature. In 15 of the 137 subjects malignant changes were diagnosed, most frequently carcinoma of the spinocellular type. Long-term studies of the cases of chronic dermatitis led to the conclusions that: early or slight pathologic changes are usually reversible and respond favorably after removal of the worker from hazardous conditions or observance of preventive measures; more severe changes of a degenerative type may be slowed down or perhaps stabilized by precautionary steps; and severe changes of a proliferative nature (precarcinomatous) are not retarded by preventive measures and the malignancy potential remains. No clear correlation was noted between the severity of the skin lesions and hematologic abnormalities. (H.H.D.)

**17917** SPACE TRAVEL: A SUGGESTED METHOD FOR PREDICTING HUMAN RESPONSE TO IONIZING RADIATION. Lawrence T. Odland and Sol M. Michaelson (Univ. of Rochester, N. Y.). Aerospace Med., 34: 62-6 (Jan. 1963).

The hazards of ionizing radiation to manned space travel are reviewed. Some of the important factors in determining biological injury to ionizing radiation are discussed, and the relation between metabolic and recovery rate is described. It is suggested that an experiment be supported wherein several species of mammals are studied under identical conditions in order to define rates of accumulation and repair of injury caused by ionizing radiation as these relate to species metabolic rate. (auth)

**17918** A CASE OF LATE CEREBRAL RADIONECROSIS. P. Girard, M. Tommasi, and B. Francois. Ann. Med.-Physchol., 120: 176-7(Jan. 1962).

The case history is described of a patient with thalamic glioma, which was treated with a 12600-r dose of x rays. Complete hemiplegia developed 21 months later and autopsy showed cerebral scarring and necrosis attributable to radiotherapy. (H.H.D.)

**17919** THE EFFECTS OF IONISING RADIATIONS ON HUMAN POPULATIONS. Atom, No. 77, 51-60(Mar. 1963).

A review of the Report of the United Nations Scientific Committee on the Effects of Atomic Radiation, issued in September 1962, is presented. The 1962 report consists of a review of the information available on the biological effects of ionizing radiation and of the doses to which mankind is at present subjected from a variety of sources. Topics covered include: radiobiology; hereditary effects; somatic effects; production, transport, and deposition of nuclear explosion debris; contamination of human diets by fission products and resulting tissue doses; $Sr^{90}$ in human bone; $Cs^{137}$ in diets and human beings; doses from short-lived isotopes; $C^{14}$ from nuclear tests; natural background radiation; medical, occupational, and other exposures; radioactive wastes; and comparison of doses and estimates of risks. (M.C.G.)

**17920** IRRADIATION OF MICE WITH FRACTIONATED DOSAGES OF X-RAYS. EFFECTS ON LONGEVITY AND TOTAL BODY WEIGHT. W. S. Moos, J. W. Yusken, R. Baratz, J. B. Fuller, J. C. Plagge, and R. A. Harvey (Univ. of Illinois, Urbana and Marquette Univ., Milwaukee). Atompraxis, 8: 398-403(Oct. 1962). (In English)

The effects of fractionated x-ray dosages on mice were investigated in regard to longevity and total body weight changes. Two different age groups of the animals were irradiated daily (5 days a week) with 2, 4, 16, 32, 64, 128, 256, and 512 r. The relationship of age and sex of the mice in their response to radiation insult was also evaluated. (auth)

**17921** LIPOXIDASE AND IONIZING RADIATIONS. J. Cheymol, M. Adolphe, and F. Heitz (Institut de Pharmacologie de la Faculté de Médecine, Paris). Bull Acad. Natl. Med. (Paris), 145: 515-17(Oct. 10, 1961).

Since ionizing radiation and lipoxidase, a soybean enzyme which oxidizes unsaturated fatty acids, both act on biological systems by the formation of peroxides, it was of interest to determine whether their effects are synergistic. In mice given a lethal (800-r) dose of whole-body x irradiation 1 hr after injection of 250 mg/kg lipoxidase, the mor-

tality curve was similar to that of animals receiving radiation alone, except on the 3rd day when the rate was slightly higher in animals treated with both enzyme and x rays. In another group of mice injected with 62 to 250 mg/kg lipoxidase before sublethal (450-r) irradiation, the enzyme only slightly increased the death rate after the 15th day. Thus, no consistent potentiating action of lipoxidase on radiation injury could be demonstrated. (H.H.D.)

**17922** PROTECTIVE EFFECTS OF PHENOL AND PROCAIN ON IRRADIATION DISEASES. J. Vanecek and V. Hlavaty (Charles Univ., Prague). Casopis Lekaru Ceskych, 102: 295-6(Mar. 15, 1963).

A protective effect against irradiation by phenol was proved. The results are discussed in light of the general antishock effect of phenol and procaine. (OTS)

**17923** EXPERIENCE WITH TOTAL-BODY IRRADIATION THERAPY. H. A. Pearson (Naval Hospital, Bethesda, Md.). Clin. Proc. Children's Hosp., 17: 150-6(June 1961).

The results of treatment of 14 patients with terminal metastatic carcinoma with a 2500-C $Co^{60}$ unit are described. Whole-body irradiation of children, with total doses of 500 r given in divided doses of 100 r on alternate days, was well-tolerated and did not give rise to nausea, vomiting, or other acute signs of radiation sickness. Marked tumor regression and transient improvement of general condition occurred, although in all 14 cases death was not prevented. The hematologic effects in the children were striking; there was an initial brief rise in peripheral white cell and platelet counts, followed by a slow progressive drop. After 2 weeks white counts were below 1500 and platelet counts under 10000, but the severe neutropenia and thrombocytopenia did not result in infection or hemorrhage. Forty days after irradiation the counts had increased to ~7000 and 125000 per $mm^3$, respectively. (H.H.D.)

**17924** MEDICATIONS FOR RADIATION THERAPY: INDICATIONS, RATIONALE, AND PRACTICE. James E. Turner (Veterans Administration Research Hospital, Chicago). Geriatrics, 18: 39-48(Jan. 1963).

Treatments are prescribed for radiation reactions in various organs irradiated for carcinoma, especially in elderly patients. It is estimated that ~10% of the medication required by irradiated cancer patients is made necessary by the radiation injury per se. (TCO)

**17925** ASPECTS AND PROBLEMS OF IMMUNITY AND INFECTION IN RADIOLESIONS: COMPREHENSIVE, CRITICAL REVIEW. G. Curatola and T. Andreoli (Centro Studi e Ricercha della Sanità Militare, Rome). Giorn. Med. Militare, 111: 388-94(July-Aug. 1961).

**17926** A NEW ANTIEMETIC FOR THE TREATMENT OF NAUSEA AND VOMITING ASSOCIATED WITH ROENTGEN THERAPY. Vincent A. Codiga (Swedish Hospital, Seattle). Intern. Rec. Med., 174: 375-9(June 1961).

Thiethylperazine dimaleate was administered orally or rectally in 56 patients for treatment of nausea or vomiting associated with radiation (2000 to 5000 r). The oral form had a quicker onset of action. Fifty patients (89%) experienced satisfactory response with either oral tablets or suppositories, the latter being used when oral tolerance was poor. Only 2 complained of side effects attributable to thiethylperazine dimaleate. One patient experienced transient blurred vision and tinnitus and another noted sialorrhea plus diminished gustatory sensation. In view of the observed high percentage of favorable responses with the drug and its lack of ataractic action, the role of psychogenic factors in gastrointestinal disturbance associated with roentgen ray therapy would seem to be slight. (H.H.D.)

**17927** RADIATION BURNS. G. Kenneth Lewis and Stuart Landa (Univ. of Illinois, Chicago). J. Intern. Coll. Surgeons, 37: 237-59(Mar. 1962).

The injurious effects of radiation, particularly in skin as a result to radiotherapy, are reviewed. Nine case histories are cited in which severe dermatitis and ulceration resulted from radium or x-ray treatment of generally benign conditions. Plastic surgical repair in these cases is described. Treatment of injury to vital internal organs resulting from external irradiation or damage to the skin, such as erythema, is determined by the area of damage and severity of the pathologic changes. Such effects as acute radiodermatitis, atrophy of the skin, indolent ulcers, and other surface or subcutaneous lesions, however, are progressive and should be recognized early. They require surgical excision and grafting before serious ulceration or malignant changes occur. (H.H.D.)

**17928** ACUTE LEUKEMIA AFTER TREATMENT WITH RADIOACTIVE IODINE. M. Cheong (Princess Alexandra Hospital, Brisbane) and R. G. Bourne. Med. J. Australia, 48: 555-6(Sept. 30, 1961).

The case history is presented of a woman who, when aged 62 years, was treated with 8 mC of $I^{131}$ for thyrotoxicosis, and who was found to have acute leukemia 15 months later. The latent period in this case was relatively short but was comparable with that seen previously in some of the 18 reported cases developing leukemia after $I^{131}$ treatment for thyrotoxicosis. This appears to be the first reported case of possible radioiodine-induced leukemia in Australia. (H.H.D.)

**17929** THE ACUTE RADIATION SYNDROME. Arne Nelson. Nord. Med., 66: 1305-8(Sept. 21, 1961). (In Swedish)

The symptoms and treatment of radiation sickness are reviewed. (H.H.D.)

**17930** MEASUREMENT OF RADIATION DOSE AFTER A REACTOR ACCIDENT. Finn Devik. Nord. Med., 66: 1320-1(Sept. 21, 1961). (In Norwegian)

Calculation of the radiation doses (207 to 436 r) received by 6 workers exposed during the Vinca (Yugoslavia) reactor accident is discussed. (H.H.D.)

**17931** LEUKEMOGENIC EFFECT OF IONIZING RADIATIONS: CRITICAL REVIEW AND PRESENT STATUS OF THE PROBLEM. F. Spinelli Ressi (Ospedale Maggiore, Milan). Osped. Maggiore, 49: 107-16(Mar. 1961).

**17932** RADIOACTIVE RADIATION INJURY: ITS ORIGIN, SYMPTOMATOLOGY, PROPHYLAXIS, AND THERAPY. R. Dolder (Kantonsapotheke, Zurich). Pharm. Acta Helv., 38: 1-14(Jan. 1963). (In German)

Drugs and techniques employed in the prevention and treatment of radiation injury are described, and there is a discussion on: the nature of ionizing radiations, both of the primary and secondary type; primary and secondary reactions of radiations with biological materials and systems; the interaction of radiations with sulfhydryl groups; the means by which human radiation injury may be incurred, from various internal and external sources; symptoms, pathology, phases, and dose-relations of radiation sickness in humans; radiosensitivity of various human tissues; and genetic effects of radiation. In addition to the radioprotective thiol compounds, such as cysteamine, cysteine, and $\beta$-aminoethylthiuronium, some protection is afforded by a variety of substances, for which the mechanism of protection is unknown, including: sympathomimetic phenylalkylamines, such as amphetamine, especially in combination with thiol compounds; phosphate esters with anticholinesterase activity, such as octaethyltetramide pyrophosphate;

serotonin; Na chlorophyll; and sitosterol. Drugs suitable for treatment of various aspects of radiation sickness in man are also discussed, including phenothiazines and barbiturates for psychic disturbances, plasma expanders for shock, antihistamines for stress reactions, antibiotics for infections, liver protectants, parenteral nutrients, antihemorrhagic agents, and hematopoietic cofactors and vitamins. Use of various chelating agents for removal of ingested radionuclides is also considered, and applications of ethylenediaminetetraacetate, diaminodiethyl ether pentaacetate, dimercaptopropanol (BAL), and Na and Zr citrate are cited. (H.H.D.)

**17933** ACUTE RADIATION SICKNESS. Floro Eduardo Mueller (Policlínico de Lanûs, Buenos Aires). Prensa Med. Arg., 48: 2041-4(July 14, 1961).

**17934** CLINICAL OBSERVATIONS ON THE THERAPEUTIC ACTION OF PROTEIN LYSATES IN THE ALTERATIONS OF THE COAGULATIVE ACTIVITY OF PATIENTS EXPOSED TO TELECOBALT THERAPY. L. Salamone, A. Coppola, A. Laconi, and G. Nalbone (Universitâ, Palermo, Italy). Radiol. Prat., 11: 277-85(May-June 1961). (In Italian)

After a review of the data and hypotheses concerning the action of radiation on the coagulative power and the behavior of platelets, the results of a study made on a group of neoplastic patients exposed to telecobalt therapy are reported. An eventual deficit of the coagulative power and the platelet ratio caused by the irradiation is documented. The therapeutic action of an amino acid complex, obtained from the enzymatic hydrolysis of proteins is indicated. It was observed that, in general, during radiotherapy a hypocoagulability state is established, affecting particularly the transitory acceleration factor, heparin tolerance, and prothrombin consumption. The platelets show a tendency, not very marked, to decrease and to hypoagglutinability. Treatment with lysates, in the majority of cases, inhibits the radioinduced damage to the coagulative factors. (tr-auth)

**17935** CHRONIC RADIUM POISONING WITH PATHOLOGIC SPONTANEOUS FRACTURES OF BOTH FEMURS. B. Cappis. Schweiz. Med. Wochschr., 91: 61-2(Jan. 14, 1961). (In German)

The case is cited of a 51-yr-old woman who had been employed 15 yr in a luminous dial factory and therefore had a history of exposure to Ra. In addition to fractures of the femurs, examination showed numerous osteolytic foci as well as osteosclerosis in other sites. Bone biopsies showed a radioactivity level over 1000 times greater than normal, and histologically a typical picture of Ra-induced osteitis was found. This was characterized by multiple micronecroses and fissures in the bone. (H.H.D.)

**17936** RADIODERMATITIS AND RADIONECROSIS. Cornelio Marcelo O'Conor. Semana Med. (Buenos Aires), 118: 135-6(Jan. 12, 1961). (In Spanish)

**17937** INVESTIGATIONS OF BIOLOGICAL RADIATION PROTECTION. PART XLVIII. THE QUANTITATIVE RELATION OF RADIATION PROTECTION BY CYSTEAMINE. Ruprecht Koch and Margarethe Langendorff (Universität, Freiburg i. B.). Strahlentherapie, 120: 269-74(Feb. 1963). (In German)

Experiments done with increasing radiation doses and increasing doses of cysteamine (1.0, 1.5, 2.0, 2.5, and 3.0 mg/20 g mouse) in total body irradiated male mice for the purpose of radiation protection showed the following results: the higher the radiation dose increases, the more cysteamine is necessary and the protection effect of cysteamine is more effective in higher dose ranges than in lower dose ranges. (auth)

**17938** UNCHANGED RADIATION SENSITIVITY OF MICE AFTER DEPRESSION OF THE SEROTONIN TISSUE LEVEL. Hans-Juergen Kuschke and Heribert Braun (Universität, Wurzburg, Ger.). Strahlentherapie, 120: 297-9 (Feb. 1963). (In German)

Lowering the tissue level of serotonin by means of inhibition of amino acid decarboxylase through the inhibitor alpha-methyl-dopa did not have any influence on survival of mice after x-ray irradiation. (auth)

**17939** ECG CHANGES AFTER X-RAY IRRADIATION OF THE HEART REGION. Tomás Grâl and Jirina Grâl (Kosice Univ., Czechoslovakia). Strahlentherapie, 120: 383-93(Mar. 1963). (In German)

The problem of radioinduced damage of the myocardium after irradiation of the heart region for mammary carcinoma or intrathoracic tumors is discussed. Analysis of patient material, including 34 cases with mammary carcinomas on the left side and 14 cases with intrathoracic tumors, showed considerable ECG-changes (ECG = electrocardiogram) in 18 and in 6 cases, respectively. Because of these results, it is assumed that damage of the myocardium caused by irradiation is possible during tangential irradiation of mammary carcinomas on the left side. This could be of importance in the future well-being of the patients. (auth)

**17940** TREATMENT OF THE RADIOINDUCED BLOOD PICTURE DAMAGE WITH VITAMIN $B_6$. Adolf Morczek and Klaus Neumeister (Strahlentherapeutische Klinik der Medizinischen Akademie, Magdeburg, Ger.). Strahlentherapie, 120: 398-404(Mar. 1963). (In German)

The therapeutic effectiveness of vitamin $B_6$ for radioinduced leucopenia was investigated in 20 female patients who received high doses of therapeutic radiation because of mammary and uterine tumors. By giving 100 mg of vitamin $B_6$ intramuscularly daily the leucocyte counts that were decreased under 3000 cells/$mm^3$ could be increased again, although irradiation was continued with unchanged doses. The therapeutic effect was proven during the course of the treatment by statistically analyzing the leucocyte counts. (auth)

**17941** LEUKOPENIA IN DEEP X-RAY THERAPY. CONTRIBUTION TO SOME QUESTIONS OF ITS CONDITIONS OR ORIGIN, ITS THERAPY, AND PROPHYLAXIS. Hans-Wolfgang Becker and Christa Becker ([Martin-Luther]-Universität, Halle-[Wittenberg], Ger.). Strahlentherapie, 120: 405-17(Mar. 1963). (In German)

Of the 1776 patients, treated with deep x-ray therapy because of malignant tumors that were examined, 8% were found to be leukopenic. Age, sex, and preceding radiation did not have dispositional influence on occurrence of leukopenia. Low initial values of leukocytes at the start of radiation, irradiation of a large area of the trunk (trunk volume-dose), level of irradiating dose, and temporal distribution do have an assured importance. In the first place, occurrence of leukopenia is related to direct radiation damage to the bone-marrow, other causes are radiogenic leukotoxins and an increased destruction of leukocytes by diapedesis. The only effective therapy for radiogenic leukopenia was interruption or scattering of the radiation. ACTH-treatment can increase the leukocytes temporarily. Prophylaxis of leukopenia by vitamin $B_{12}$ was not successful. (auth)

**17942** MODEL EXPERIMENT ON CHEMICAL RADIATION PROTECTION. PART III. PROTECTIVE EFFECTS OF NON-REDUCING MATERIALS AGAINST PERMEABIL-

ITY DISTURBANCES BY X-RAY IRRADIATED ERYTHROCYTES. Kurt Flemming (Universität, Freiburg i. B. and Heiligenbert-Instituts, Ger.). Strahlentherapie, 120: 456-69(Mar. 1963). (In German)

A large number of non-reducing agents (amino acids, carbonic acids, amines, urea, and phenyl urea) were tested with roentgen hemolysis and preceding disturbances of permeability of the erythrocyte membrane (cell distension, loss of potassium) for a protective effect against x rays and were compared with the reducing cystein. The functional groups (COOH, $NH_2$, OH, and SH) causatively participate in the protective action of the aliphatic compounds. The non-reducing groups (COOH, $NH_2$, and OH) are capable to attract oxidizing radicals from oxidizable objects in basically the same way, as the reducing SH-group; thereby they loose their protective action. Since oxidizability of the non-reducing groups is slight compared to the oxidizability of the reducing SH-group, their protective action against radiation is weak accordingly. The strong protective action of aromatic compounds depends on the benzoid-ring-like structure. Presumably the delocalized π-electrons of this structure bring about such a neutralization of the irradiating energy that the aromatic substance can be operative repeatedly in the same way. In this connection the concept on the mechanism of "extinction of fluorescence" in uv-radiated solutions, and on "energy-transfer by resonance" is pointed out. Besides the possibility is discussed, that even in the presence of water direct effects of radiation could participate more strongly than was generally accepted in the last decade. (auth)

**17943** CONCERNING THE EFFECTS OF A SERIES OF PROTECTIVE MATERIALS IN IRRADIATION OF CATTLE SERUM WITH ULTRAVIOLET LIGHT AND X RADIATION. Hermann Engelhard and Wolf von Berg (Universität, Göttingen, Ger.). Strahlentherapie, 120: 470-8(Mar. 1963). (In German)

The protective effect of a few substances to UV-light and x-ray irradiation of cattle serum was investigated electrophoretically. It was shown that the mechanism of the protective substances during irradiation with UV-light is produced by competitive absorption and filter effects. For the best protection in vivo the use of a light protective creme for external application is recommended as a filter against UV-light. For the protection against x rays the injection of a protective substance is recommended. (auth)

# CHEMISTRY

## General and Miscellaneous

*Refer also to abstract 18333.*

**17944** (BNL-6279) VAPOR PRESSURES OF ISOTOPIC MOLECULES. Jacob Bigeleisen (Brookhaven National Lab., Upton, N. Y.). [1962]. Contract [AT(30-2)-Gen-16]. 31p.

A discussion of the general theory related to the vapor pressure of isotopic molecules is presented. A number of specific structural effects are examined and compared with experimental results. It is noted that good agreement is evident in data on vapor pressure gathered by various laboratories throughout the country. Techniques and data related to laboratory programs are now useful in studies of quantum and structural effects in liquids and solids. (J.R.D.)

**17945** (BNL-6852) FISSION FRAGMENT ENERGY DEPOSITION EFFICIENCY FOR THIN URANIUM-CONTAINING ELEMENTS AND THE FIXATION OF NITROGEN. Meyer Steinberg, Marco Loffelholz, and Jacob Pruzansky (Brookhaven National Lab., Upton, N. Y.). Mar. 1963. Contract [AT(30-2)-Gen-16]. 57p.

It is noted that in chemonuclear reaction systems the efficiency of conversion of nuclear to chemical energy is directly related to the fraction of the total fission fragment recoil energy liberated in the system which is directly absorbed by the chemical reactant. This fraction is termed the fission fragment energy deposition. The use of gas dosimetry for determining the deposition efficiency is described, and G value data are given for nitrogen fixation by fission fragment energy. (J.R.D.)

**17946** (EUR-165.e) DENSITY AND SURFACE-TENSION MEASUREMENTS OF PURE POLYPHENYLS AND SOME POLYPHENYL MIXTURES. G. Friz and H. Vossen (European Atomic Energy Community. Nuclear Research Center, Ispra, Italy). 1963. 16p.

Capillary methods for determining the density and the surface tension of polyphenyls are presented. Density is determined by measuring the length of a liquid thread and weight difference. Above the boiling point a sealed capillary is used. Surface tension is measured by the horizontal capillary method with optical observing of the liquid surface at the capillary end. Results are presented for diphenyl-, terphenyl-isomers and two industrial mixtures. (auth)

**17947** (NYO-9873) CALCULATION OF PSEUDO-LATTICE ENERGIES AND THE ESTIMATION OF METAL-LIGAND BOND ENERGIES IN SOME TETRAHEDRAL TETRACHLOROMETALLATE(II) COMPLEXES. A. B. Blake and F. A. Cotton (Massachusetts Inst. of Tech., Cambridge. Dept. of Chemistry). Mar. 15, 1963. Contract AT(30-1)-1965. 29p.

A method of calculating the pseudo-lattice energy, that is, the energy required to separate a crystalline compound containing complex ions into gaseous species so that the complex ions remain intact, is described in detail. The feasibility of the method depends on the availability of an efficient program for machine computation of Madelung energies; such a program is described. It is shown how the pseudo-lattice energy may be used together with experimentally accessible thermodynamic data to calculate the complexation or ligation energy, i.e., the energy released when a gaseous complex ion is formed from a gaseous metal ion and gaseous ligands. The entire procedure is illustrated for the complex ions $[CoCl_4]^{2-}$, $[CuCl_4]^{2-}$, and $[ZnCl_4]^{2-}$, and in the case of $[CoCl_4]^{2-}$ a valuable check is provided by the excellent agreement between the results obtained using $Cs_2CoCl_4$ and $Cs_3CoCl_5$. The significance of the energies of complexation in relation to problems of the relative stability of different coordination numbers and configurations is briefly discussed. (auth)

**17948** (NYO-9874) THE CRYSTAL AND MOLECULAR STRUCTURE OF BIS(TRIMETHYLPHOSPHINE OXIDE) COBALT(II) DINITRATE. F. A. Cotton and R. H. Soderberg (Massachusetts Inst. of Tech., Cambridge. Dept. of Chemistry). Mar. 20, 1963. Contract AT(30-1)-1965. 29p.

The crystal structure of bis(trimethylphosphine oxide) cobalt(II) dinitrate was determined using three-dimensional x-ray-diffraction data. Although magnetic and spectroscopic data had suggested tetrahedrally coordinated Co, it is found that the Co is six-coordinated with a very irregular arrangement of ligand atoms, possessing no strict symmetry elements whatever and only one quasi or approximate one, a two-fold axis. Other results reported are: the P-O-Co groups are bent (~133°, ~139°); the P–O bond is longer than in the free $(CH_3)_3PO$ molecule; and the nitrate ions are bidentate but little distorted from their inherent $D_{3h}$ symmetry. (auth)

**17949** (ORNL-TM-449) CHEMICAL TECHNOLOGY DIVISION. CHEMICAL DEVELOPMENT SECTION C. Progress Report, July–December 1962. K. B. Brown (Oak Ridge National Lab., Tenn.). Apr. 22, 1963. Contract [W-7405-eng-26]. 93p.

Studies were continued on the phenol extraction process for the recovery of Cs from waste liquors and on the di(2-ethylhexyl)phosphoric acid process for the recovery of Sr and rare earths from adjusted Purex 1WW waste. In the Tramex process, studies were made on the solubility of $AlCl_3$ in LiCl solutions and on the stabilization of Ru in an inextractable form by hydrazine hydrochloride. Various possible extraction systems for the separation of transplutoniums and lanthanides were tested. Extraction coefficients were measured for a large number of metal ions from chloride solutions, using amines. The relative extractabilities of the alkaline earths by di(2-ethylhexyl) phosphoric acid from nitrate medium were found to be in the order Ca > Mg > Sr > Ba at low salt loadings; at higher loadings, the positions of Sr and Ba are reversed. In the use of 4-sec-butyl-2-(α-methylbenzyl)phenol to separate Cs from alkaline ore leach liquors, more than 98% of the Cs was separated efficiently from other alkali metals. Studies were made on the acid leaching of Th from Conway granite samples. An evaluation was made of the Conway granite formations in New Hampshire as a source of Th. Studies were made on the removal of Ra from uranium mill effluents, and a large number of materials was found to adsorb Ra effectively from synthetic lime-neutralized mill waste. (D.L.C.)

**17950** (TID-18343) PHOTOCHEMICAL REACTIONS OF COMPLEX MOLECULES IN CONDENSED PHASE. Progress Report, May 1, 1962–April 30, 1963. Henry Linschitz (Brandeis Univ., Waltham, Mass.). Mar. 15, 1963. Contract AT(30-1)-2003. 13p.

Factors which affect channeling of energy flow through excited systems and the oxidation/reduction reactivity of excited molecules are reported. Discovery and characterization of a new metastability type (photochromism) is reported. Other work led to proof of the lack of spin-dependent factors in the quenching of singlet and triplet excited states of aromatic molecules and to the direct measurement of the essential rate constants for the various processes involved in the photochemical reduction of benzophenone to benzpinacol. Establishment of the molecular reaction site in low-temperature-controlled photooxidation of chlorophyll is reported along with the electrochemical reduction of porphyrins and chlorophyll. The interaction between $FeCl_3$ and LiCl in organic solvents was examined. (J.R.D.)

**17951** (TID-18349) [TRANSPORT AND THERMODYNAMIC PROPERTIES OF SOLUTIONS.] Annual Progress Report, January 1, 1962–January 1, 1963. (Yale Univ., New Haven). March 27, 1963. Contract AT(30-1)-1375. 15p.

Activities in a program to examine transport properties and related thermodynamic properties of nonaqueous systems are reported. The aim in this program is to connect by experiment such irreversible properties as self-diffusion coefficients, binary self-diffusion coefficients, viscosities, and Soret coefficients with certain equilibrium properties of the solutions. Data are included on diffusion coefficients, viscosities, and densities over the entire concentration range at 25 and 35°C for the heptane-benzene system. Preliminary data are also discussed on transport and related thermodynamic properties of aqueous solutions and on self-diffusion of binary nonaqueous systems. (J.R.D.)

**17952** (TID-18418) MERCAPTAN INHIBITION OF THE DEPOLARIZATION OF A SMOOTH PLATINUM CATHODE. Technical Report No. XLIV. Joel Jacknow and Henry Eyring (Utah. Univ., Salt Lake City. Inst. for the Study of Rate Processes). Mar. 15, 1963. Contract AT(11-1)-1144. 62p.

The inhibitory effect of 4 to 14 carbon N-mercaptans on the oxidation of hydrogen by hydrogen peroxide on a smooth platinum cathode has been studied in aqueous solution as a function of pH, and in acetic acid solution as a function of acid concentration. When hydrogen is plated onto a platinum cathode in a stirred aqueous oxidizing medium, and the circuit is then broken, depolarization of the electrode takes place. The potential moves back to the steady-state potential of the redox couple with the potential-time curve showing three distinct parts. The first step is the quick disappearance of the over-voltage in which the potential drops to the reversible hydrogen potential, $E_H$. The second step is diffusion controlled by the oxidant. The adsorbed hydrogen is removed by the oxidizer with the potential increasing linearly with time to $E_H + 275$ mv. The third step is an exponential decay to the steady-state redox potential. When mercaptans are added to the solution, the same kind of depolarization curve is obtained except for longer elapsed times. The degree of adsorption of the mercaptans is measured by this inhibition as given by the lengthening of the linear second step. Mercaptans inhibit the reaction by blocking those surface sites at which electrons are transferred to the oxidant. Studies of adsorption systems using an homologous series of surfactant materials usually proceed by comparing the results with Traube's law. This rule states that as one ascends a series the adsorption progressively increases. Another widely used generalization is that the least soluble substances are the most adsorbable. Both of these rules have been quantitatively combined in an expression for the net free energy of adsorption. This net free energy was then used in a Langmuir adsorption isotherm to give a general expression for adsorption from solution. Increasing the acetic acid concentration increases the solubility of the mercaptan. Thus, the inhibition of the lower mercaptans is greatest at the lowest acetic acid concentration. However, the inhibition of the higher mercaptans is lowest at low acid concentrations, increasing as the acid content is raised, passing through a maximum, and then decreasing again. The inhibition maximum is at higher acetic acid concentrations for the higher molecular weight compounds. The deviation from the above two generalizations is indirectly due to the low solubility of these higher homologs. The low solubility does not allow a great enough flux of mercaptan to the platinum surface to balance the adsorbed mercaptan which is being oxidized by the peroxide. Therefore, a steady state surface coverage of the mercaptan is achieved which is lower than that predicted by the general equation for adsorption. This effect is, hence, greatest for the higher and least soluble homologs. Equations have also been obtained which relate the inhibitory effect to the surface coverages of the hydrogen and mercaptan. (auth)

**17953** (TID-18448) ANNUAL PROGRESS REPORT [ON TRANSPORT AND THERMODYNAMIC PROPERTIES OF AQUEOUS SOLUTIONS], JANUARY 1, 1962 TO JANUARY 1, 1963. (Yale Univ., New Haven). Mar. 1963. Contract AT(30-1)-1375. 15p.

Work on the thermodynamic properties of aqueous solutions, mixed solvent systems, and nonaqueous systems is reviewed. The Hartley-Crank equation for describing binary diffusion coefficients in nonaqueous systems is discussed. Measurements of diffusion coefficients and viscosities are reported for the system heptane–benzene at 25 and 35°C, and results of analysis of the data are given. Self-diffusion coefficients of heptane and methanol at 25°C are given. The Kirkwood-Fixman-Beaman theory of thermal diffusion in binary systems is discussed briefly. (D.L.C.)

**17954** (TID-18450) STUDY OF APPLICATIONS OF THE MÖSSBAUER EFFECT IN SCIENCE AND TECHNOLOGY. Quarterly Progress Report, October 15, 1962–January 15, 1963. L. M. Epstein (Westinghouse Electric Corp. Research Labs., Pittsburgh). Contract AT(30-1)-2989. 21p.

Progress in work on the Mössbauer effect is reported. A constant-velocity-strobe spectrometer is described, and results obtained using this instrument are compared with those obtained using a velocity-scan spectrometer. Results of measurements concerning the temperature dependence of nitrophenanthroline ferrous perchlorate isomer shifts are included along with results of initial research on the Mössbauer effects in $Kr^{83}$. (J.R.D.)

**17955** (TRG-Inf-Ser-278) CALCULATION OF THE SEPARATING CHAMBER OF COLUMN EXTRACTORS WITH PERFORATED PLATES. A. N. Planovskii and C. N. Bulatov. Translated by A. G. Hamlin (U.K.A.E.A. Risley, Lancs, Eng.) from Khim. Mashinostr., No. 3, 9-11(1960). 4p.

It was previously shown that in calculation of overflow arrangements for dense liquids from column extractors with perforated plates, it is insufficient to proceed solely from an equilibrium condition of extractor liquid column pressure and overflow. A device is required for overflow height regulation, the use of which results in known inconveniences in extractor exploitation. Aspects of separa-

tion chamber interphase surface level height determination when heights of overflow are specified are examined. Results of this height determination are related to the required height of the separating chamber for ensuring that the position of the interphase surface level is maintained under specified extractor loadings with respect to continuous and disperse phases. (J.R.D.)

**17956** THE PREPARATION OF METALLIC URANIUM AND BERYLLIUM BY FUSED SALT ELECTROLYSIS. Tadashi Kuroda, Osamu Matsumoto, Tadashi Suzuki, and Shigeo Hasegawa. Bull. Tokyo Inst. Technol., Spec. No. 49: 195-203(1963). (In English)

Processes, equipment, and typical results are described for the respective preparation of metallic U and Be from $UCl_4$ and $BeCl_2$. The preparation of the chlorides from the oxides is also described. (D.L.C.)

**17957** CHEMICAL APPLICATIONS OF NUCLEAR MAGNETIC DOUBLE RESONANCE. John D. Baldeschwieler and Edward W. Randall (Harvard Univ., Cambridge, Mass.). Chem. Rev., 63: 81-110(Apr. 1963).

A review of nuclear magnetic double resonance (simultaneous irradiation of a system at two different frequencies) is given which is limited to high-resolution studies with liquids. Applications of double resonance include analysis of NMR spectra, measurement of chemical shifts and coupling constants, and intermediate amplitudes of the oscillatory fields. Instrumentation and specific applications are described. A bibliography of 107 references is included. (D.L.C.)

**17958** KINETIC ISOTOPE EFFECT IN PHOTOCHLORINATION OF $H_2$, $CH_4$, $CHCl_3$, AND $C_2H_6$. G. Chiltz, R. Eckling, P. Goldfinger, G. Huybrechts, H. S. Johnston, L. Meyers, and G. Verbeke (Université Libre, Brussels and Centre d'Enseignement et de Recherches des Industries Alimentaires et Chimiques, Brussels). J. Chem. Phys., 38: 1053-61(Mar. 1, 1963).

The relative rates of hydrogen and deuterium abstraction by chlorine atoms from $H_2-D_2$, $CH_4-CD_4$, and $C_2H_6-C_2D_6$ in direct competition were studied by a mass spectrometer technique permitting direct determinations of rates. The pair $CHCl_3-CDCl_3$ was investigated by a substitution–addition competition with $C_2Cl_4$. Data were obtained between 300 and 475°K, and values of $k_H/k_D$ ranged between 3.64 and 10.9 for $CH_4/CD_4$, 2.37 to 2.69 for $C_2H_6/C_2D_6$, 1.58 to 2.26 for $CHCl_3/CDCl_3$, and 4.7 to 8.9 for $H_2/D_2$. For the family of reactions involving C–H–Cl, an extensive series of model calculations were made by the "bond-energy-bond-order" method. The expected variation of activation energy with heat of reaction was computed and compared with experiment. The expected variation of kinetic isotope effect with both temperature and heat of reaction was computed for a range of conditions much wider than these experiments. Simple activated complex theory predicts several strong trends of kinetic isotope effect with heat of reaction. The data, in a general semiquantitative way, follow these predicted trends, but in terms of fine details the data do not fit the theoretical lines. In view of the known simplifications in activated complex theory, this agreement with broad trends is all that anyone should expect. (auth)

**17959** INFLUENCE OF STRUCTURE ON GASEOUS PRODUCTS FROM $C^{11}$ RECOIL REACTIONS IN $C_6$ HYDROCARBONS. Edward P. Rack, Charles E. Lang, and Adolf F. Voigt (Ames Lab., Ames, Iowa). J. Chem. Phys., 38: 1211-15(Mar. 1, 1963). (IS-512)

Results are presented on the yields of gaseous products resulting from recoil reactions of $C^{11}$ in various $C_6$ hydrocarbons: benzene, n-hexane, 2-methylpentane, and 2,2-dimethylbutane. The $C^{11}$ was produced by the $C^{12}(\gamma,n)C^{11}$ reaction in the target molecule. The radiation time and dose were varied, and iodine was added as a scavenger. Comparison was made with similar results on cyclohexane. In all cases, acetylene is the most abundant product, but as branching in the molecule increases, other products, principally ethylene and ethane, become increasingly important. The results are in agreement with a mechanism involving the insertion of an energetic $C^{11}$ or $C^{11}H$ group into a C–H bond, followed by bond rupture in the resulting intermediate. (auth)

**17960** EXCHANGE PROPERTIES OF AMMONIUM SALTS OF 12-HETEROPOLYACIDS. IV. Cs EXCHANGE ON AMMONIUM PHOSPHOTUNGSTATE AND PHOSPHOMOLYBDATE. J. Krtil (Inst. of Nuclear Research, Rez, Czechoslovakia). J. Inorg. Nucl. Chem., 24: 1139-44 (Dec. 1962).

Functional relations have been established describing cesium sorption on ammonium phosphotungstate ($NH_4PW$) and ammonium phosphomolybdate ($NH_4PMo$) as a function of the concentrations of nitric acid, ammonium nitrate, and cesium in the solution, and on the amount of sorbent. (auth)

**17961** A CARBON ISOTOPE EFFECT IN THE DECARBOXYLATION OF THE ANISOYLOXY RADICAL. T. H. Bates and J. C. Bevington (Univ. of Birmingham, Eng.). Nature, 197: 1294-5(Mar. 30, 1963).

A carbon isotope effect was demonstrated during the dissociation of the anisoyloxy radical generated by the decomposition of di-anisoyl peroxide in benzene at 60°C. The production of $CO_2$ was followed by isotope dilution analysis using peroxide labeled with $C^{14}$ at the carboxyl groups as the source of anisoyloxy radicals. The specific activity of the carbon dioxide produced during the decomposition was calculated from that of the original peroxide. (C.H.)

**17962** XENON TETRAFLUORIDE: HEAT OF FORMATION. Stuart R. Gunn (Univ. of California, Livermore) and Stanley M. Williamson. Science, 140: 177-8(Apr. 12, 1963).

Calorimetric measurements of the heat of reaction of xenon tetrafluoride with aqueous iodide solution give −60 kilocalories per mole for the standard heat of formation, or an average thermochemical bond energy of about 31 kilocalories. (auth)

**17963** XENON TETRAFLUORIDE: FLUORINE-19 HIGH-RESOLUTION MAGNETIC RESONANCE SPECTRUM. Thomas H. Brown, E. B. Whipple, and Peter H. Verdier, (Union Carbide Research Inst., Tarrytown, N. Y.). Science, 140: 178(Apr. 12, 1963).

The $F^{19}$ spectrum of $XeF_4$ dissolved in anhydrous hydrogen fluoride was observed at two frequencies, yielding a $F^{19}$ chemical shift of 175 parts per million to lower field than the solvent and a $Xe^{129}-F^{19}$ spin-spin coupling constant, confirmed by double irradiation, of 3860 cycles per second. Absence of fast $F^{19}$ chemical exchange and collapse of the $Xe^{131}-F^{19}$ coupling by quadrupole relaxation may be inferred from the spectrum. (auth)

**17964** INFRARED SPECTROSCOPY INVESTIGATIONS OF COORDINATION COMPOUNDS OF $AlH_3$ AND $AlD_3$ IN SOLID AND GASEOUS STATES. VI. COMMUNICATION ON THE MOLECULAR PHYSICS INVESTIGATION OF THE INFORMATION ON COORDINATIVE BONDING. Hilmar Roszinski (Institut für Chemie der Treibstoffe, Berg-

hausen, Ger.), Rolf Dautel, and Werner Zeil. Z. Physik. Chem. (Frankfurt), 36: 26-52(Jan. 1963). (In German)

Some coördination compounds of $AlH_3$ and $AlD_3$ in solid and gaseous states were investigated by infrared spectroscopy in the region from 1 to 24 $\mu$. In the gaseous state the monoadducts appeared with trimethylamine monomers while they were associated in the solid state. The diadducts with trimethylamine in the gaseous state were partly dissociated into monoadducts and trimethylamine. For the monoadducts with tetrahydrofuran a polymeric chain structure could probably be made. The diadducts had a lower symmetry than the previously assumed symmetry $D_{3h}$. (tr-auth)

**17965** PROCESS OF PRODUCING A NIOBIUM-TIN COMPOUND. Sylvester T. Zegler and Joseph B. Darby, Jr. (to U. S. Atomic Energy Commission). U. S. Patent 3,084,041. Apr. 2, 1963.

This patent deals with a process of preparing pure $Nb_3Sn$. The process comprises heating powders of niobium and excess tin to 900 to 1000°C, whereby niobium reacts with the molten tin under the formation of $Nb_3Sn$; cooling and powdering the product and immersing the powder in concentrated hydrochloric acid for removal of excessive tin; separating the $Nb_3Sn$, rinsing and drying it and sintering it in an inert atmosphere at 900 to 1300°C. (AEC)

## Analytical Procedures

**17966** (HW-SA-2663) DETERMINATION OF NITROGEN AS URANIUM NITRIDES IN FUSED URANIUM DIOXIDE ($UO_2$). Harlan J. Anderson and James C. Langford (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). July 12, 1962. Contract AT(45-1)-1350. 8p.

A Kjeldahl digestion technique that uses a mixture of 1:1 diluted hydrochloric acid with additions of copper selenate and hydrofluosilicic acid was successfully used to analyze the nitrogen content (UN, $U_2N_3$, $UN_2$) in fused uranium dioxide ($UO_2$). Usual digestion techniques and vacuum extraction at 1000°C were inadequate for analysis of all uranium nitride species present in (fused) $UO_2$. (auth)

**17967** (PG-Report-250) ANALYTICAL METHOD FOR THE POTENTIOMETRIC DETERMINATION OF CHLORIDE IN PURE URANYL NITRATE SOLUTIONS. (United Kingdom Atomic Energy Authority. Production Group, Springfields, Lancs, England). 1963. 10p.

Chloride is co-precipitated with silver iodide. Silver is removed by treatment of the precipitate with ammonium hydroxide and zinc. The iodide is oxidized to iodine and removed by extraction into benzene. The chloride content is then determined from the potential difference across a silver/silver chloride concentration cell. The method is applicable to pure uranyl nitrate solutions containing 100 to 2000 $\mu$g chloride in the aliquot taken. The standard deviation should not exceed 10% relative at the lower limit quoted, and should reduce progressively at higher chloride concentrations. (auth)

**17968** (PG-Report-339) ANALYTICAL METHOD FOR THE TURBIDIMETRIC DETERMINATION OF CHLORIDE IN VANADIUM. (United Kingdom Atomic Energy Authority. Production Group, Springfields, Lancs, England). 1963. 5p.

The sample is dissolved in a mixture of nitric and sulfuric acids. The chloride is distilled and determined turbidimetrically. The method is suitable for chloride contents in the range of 100 to 800 ppm. The standard deviation is ±10 $\mu$g at a level of 300 $\mu$g chloride. (auth)

**17969** (PG-Report-347) ANALYTICAL METHOD FOR THE SPECTROGRAPHIC DETERMINATION OF CALCIUM AND ALUMINIUM IN MAGNOX MN 70 ALLOY. (United Kingdom Atomic Energy Authority. Production Group, Springfields, Lancs, England). 1963. 14p.

The sample is dissolved in hydrochloric acid, and scandium internal standard is added. The solution is excited by a rotating copper disk technique using a 15-kv spark, and the spectra are recorded through a medium quartz spectrograph. The method is suitable for the determination of 50 to 400 ppm calcium and 150 to 2000 ppm aluminum in magnesium alloys containing 0.55 to 0.85% manganese. Using a bulk standard solution, prepared from the synthetic alloy base solution, the standard deviations for the spectrographic finish were found to be: 23 ppm aluminum at the 500 ppm level and 15 ppm calcium at the 200 ppm level, calculated from duplicate exposures. (auth)

**17970** (PG-Report-357) ANALYTICAL METHOD FOR THE DETERMINATION OF BETA ACTIVITY IN BOREHOLE WATER. (United Kingdom Atomic Energy Authority. Production Group, Springfields, Lancs, England). 1963. 10p.

A portion of the sample is concentrated to a low bulk and transferred to a counting tray. It is then evaporated to dryness, and the beta activity is measured in a counter employing an anticoincidence system to reduce background activity. The method is suitable for the determination of trace beta activity in liquid samples of large volume and small total solids content. The lower limit of detection is $0.1 \times 10^{-8}$ $\mu$c/ml. The standard deviation is ±8% at the $0.5 \times 10^{-8}$ $\mu$c/ml level of activity. (auth)

**17971** (PG-Report-415) ANALYTICAL METHOD FOR THE ABSORPTIOMETRIC DETERMINATION OF BORON IN SODIUM METAL. (United Kingdom Atomic Energy Authority. Production Group, Springfields, Lancs, England). 1963. 7p.

Sodium metal is dissolved in water under an inert atmosphere of argon, and the resulting sodium hydroxide solution is evaporated to dryness. Rosocyanin is formed, separated from excess curcumin, and dissolved in ethanol for absorptiometric measurement. The method is applicable to sodium metal containing 0.1 to 1 ppm boron. The precision should be within ±20% (95% confidence limits) at the 0.5 ppm boron level. (auth)

**17972** (PG-Report-434) ANALYTICAL METHOD FOR THE DETERMINATION OF COPPER IN BOILER FEED WATER. (United Kingdom Atomic Energy Authority. Production Group, Windscale, Sellafield, England). 1963. 5p.

The Cu is extracted into $CCl_4$ as its yellow dibenzyldithiocarbamate complex, and its concentration is determined absorptiometrically. (auth)

**17973** (TRG-Report-466) A SEMI-MICRO THERMOBALANCE FOR PLUTONIUM COMPOUNDS. J. L. Drummond and H. Chapman (United Kingdom Atomic Energy Authority. Reactor Group, Dounreay, Caithness, Scotland). Jan. 15, 1963. 11p.

The construction of a sensitive thermobalance is described. It was designed for the study of the oxidation and reduction reactions of mixed uranium-plutonium oxides, and for the gravimetric determination of the oxygen-to-metal ratio of such oxides, where precise measurement of small changes in weight is necessary. The design is based on an analytical semi-micro balance. Installation

details and performance test results are presented. Individual weighings are reproducible to ±0.02 mg with a 0.5–1.0 g sample at temperatures of 1300°C in a slow current of any selected gas at atmospheric pressure. Minor modifications to the design will permit an investigation of the preparation and properties of uranium and plutonium carbides and nitrides. (H.G.G.)

**17974** (UCRL-7204) THE DETERMINATION OF SULFUR IN BERYLLIUM OXIDE AND SINTERED BERYLLIUM OXIDE FUEL ELEMENTS. Walter G. Boyle, Jr., Lewis J. Gregory, and William Sunderland (California. Univ., Livermore. Lawrence Radiation Lab.). Jan. 16, 1963. Contract [W-7405-eng-48]. 11p.

A dry combustion procedure for determining S in BeO and BeO fuel elements is described. The sample combined with Fe and Sn is burned in a stream of $O_2$ in an induction furnace, and the resulting $SO_2$ is titrated continuously with $I_2$. Conditions for determining levels of S content around 10 ppm as well as the higher levels are presented, and typical analytical results are summarized. (auth)

**17975** (UCRL-10324) MICROACTIVATION ANALYSIS FOR OXYGEN IN THE ACTINIDE METALS. André C. Demildt (California. Univ., Berkeley. Lawrence Radiation Lab.). July 19, 1962. Contract W-7405-eng-48. 15p.

$He^3$-activation analysis, by use of the Hilac at the Lawrence Radiation Laboratory in Berkeley, was found ideal for oxygen determination. Oxygen can be determined in as low a concentration as 0.001% in a few hundred μg of matrix material. Interference by activation of other elements can be restricted by control of the bombarding energy of the $He^3$ particles. This makes the method applicable to the analysis of fissionable actinides because only small amounts of material are available. (auth)

**17976** (AEC-tr-5696) X-RAY FLUORESCENCE ANALYSIS USING RADIOISOTOPES. Shigemasa Enomoto and Chikao Mori. Translated from Nippon Isotope Kaigi Hobunshu, No. 4, 566-9(1961). 13p. (Includes original, 6p.).

When radioisotopes are used for x-ray fluorescence analysis, the radiation intensity is less than with previously used methods, and a crystal grating cannot be used for spectroscopic purposes. It becomes necessary to rely on a spectroscopic method that uses a filter utilizing resonant absorption edge or pulse height analysis. The detecting efficiency of these methods is ~$10^4$ times as great as with the use of crystal gratings. $Sr^{90}$–$Y^{90}$ beta, $Sr^{90}$–$Y^{90}$ beta excited x rays, and $H^3$ beta excited x rays were used as sources in the above mentioned methods for analyzing alloys and measuring coating thickness. Results are presented. (H.G.G.)

**17977** (JPRS-18632) A RAPID METHOD FOR DETERMINING THE STRONTIUM-90 CONTENT OF MILK. M. M. Golutvina, T. A. Kazakova, and Yu. M. Nikolaev. Translation of Vopr. Pitaniya, 22: 66-9(1963). 9p. (OTS-63-21550)

A description is presented of a rapid extraction method for determining $Sr^{90}$ content in milk. The procedure is based on the extraction of $Y^{90}$, which is in equilibrium with $Sr^{90}$ in milk, by means of tributylphosphate, with subsequent re-extraction of yttrium into water and measurement of its radioactivity on a low-background unit. The proposed method may be employed for the purpose of administrative control and check-up. (auth)

**17978** (UCRL-Trans-916(L)) PRECIPITATION AND DETERMINATION OF BERYLLIUM IN THE OXIDE STATE. Thérèse Dupuis. Translated by Sergey Shewchuck (Univ. of California Lawrence Radiation Lab., Livermore) from Mikrochem. Ver. Mikrochim. Acta, 35: 477-87(1950). 14p.

The pyrolysis curves of various Be compounds were traced up to about 1000°C with the aid of the Chevenard thermobalance in a program to determine the temperature to which precipitates (mainly hydroxide) should be brought before being weighed. Special attention is directed to the determination of Be from its oxide as produced from the hydroxide. (J.R.D.)

**17979** ISOTOPIC ANALYSIS BY MEANS OF OPTICAL SPECTROSCOPY. II. MOLECULAR SPECTRA. H. Tintea, C. Ungureanu, and E. Weissmann (Institutul de Fizica Atomica, Cluj and Universitatea "Babes-Bolyai." Cluj). Acad. Rep. Populare Romine, Studii Cercetari Fiz., 13: 485-500(1962). (In Rumanian)

Infrared spectra, rotation and infrared rotation-vibration spectra, Raman spectra, and other molecular spectra exhibit isotopic effects which may be used in isotopic assay. Diffraction gratings or prisms are used for the study of molecular spectra in the visible range, making use of photographic or photoelectric methods. High-frequency, electrode-free discharge tubes serve as light sources for emission spectra, while for absorption studies in the ultraviolet range H lamps are used; Globar rods were found to be satisfactory in the infrared range. The assay of heavywater–light water mixtures represents one of the most important applications of the infrared absorption analysis. For the $D_2O$ concentrations the 2.94 μ band is used, while for intermediate and low $D_2O$ concentrations the 1.47 and the 3.95 μ bands, respectively, were found to be satisfactory. The methods reported in the literature for the determination of the isotopic composition of B, C, N, O, Cl, and Po are reported critically. It is concluded that optical spectroscopy offers the advantages of low cost and relative simplicity with respect to mass spectroscopic methods while retaining the level of accuracy and sensitivity of the latter. (TTT)

**17980** NEW RADIOACTIVE GAS CHROMATOGRAPHIC DETECTOR FOR IDENTIFICATION OF STRONG OXIDANTS. B. J. Gudzinowidz and W. R. Smith (Monsanto Research Corp., Everett, Mass.). Anal. Chem., 35: 465-7 (Apr. 1963).

Recent investigations using a krypton-85 quinol clathrate as a source of radioactivity have shown that some gaseous inorganic oxidants eluted from gas chromatographic columns react with the clathrate, releasing krypton atoms, which subsequently can be detected by a Geiger ratemeter. Comparison of the chromatogram and the ratemeter trace identifies the oxidants in a gas mixture. In addition to fluorine, which could be detected quantitatively at a 1 to 20 ppm concentration level in air, qualitative results of exploratory studies showed the following gases to possess high reactivity with the $Kr^{85}$ clathrate: $Br_2$, $NO_2$, $OF_2$, $Cl_2$, $NO_2F$, and $NO_2Cl$. (auth)

**17981** A COMPACT RADIOCHEMICAL GAS CHROMATOGRAPH. A. T. James and E. A. Piper (National Inst. for Medical Research, London). Anal. Chem., 35: 515-20(Apr. 1963).

A compact gas chromatograph is described in which the column is connected directly to a combustion tube in which all organic compounds are burnt to $CO_2$ and water. The water is reduced to hydrogen by iron filings. The gas stream passes to a miniature katharometer in which the hydrogen is detected. After injection of 5% of $CO_2$, the mixed gases enter a simple proportional counter which can record the ionization radiation from either $C^{14}$ or

tritium with efficiencies of approximately 100% for $C^{14}$ and 60% for tritium. The apparatus is sensitive, simple, and cheap to construct. (auth)

**17982** MEASUREMENT OF TRITIUM IN THE EFFLUENT OF A GAS CHROMATOGRAPHY COLUMN. Arthur Karmen, Irmgarde McCaffrey, James W. Winkelman, and Robert L. Bowman (National Heart Inst., Bethesda, Md.). Anal. Chem., 35: 536-42(Apr. 1963).

Two methods for assaying tritium in compounds analyzed by gas chromatography are described. When the tritium in each component is sufficient for accurate assay in less than 10 seconds, the assay is performed during the analysis. The column effluent is passed through a combustion train consisting of a heated tube containing copper oxide in which organic materials are converted to carbon dioxide and water; a tube containing heated iron, maintained in the reduced state by a stream of hydrogen gas, in which the water reacts to liberate tritium-labeled hydrogen gas; a magnesium perchlorate water trap; and an ionization chamber or a transparent tube filled with anthracene crystals for scintillation counting. When the samples contain insufficient tritium, the effluent is passed through cartridges containing p-terphenyl crystals coated with silicone oil. High boiling materials are trapped and retained. Each cartridge is transferred to a vial containing diphenyloxazole–toluene for radioassay by liquid scintillation counting for the time required for statistically accurate results. (auth)

**17983** RADIOISOTOPIC ASSAY FOR NEOMYCINS B, C, AND NEAMINE. D. G. Kaiser (Upjohn Co., Kalamazoo, Mich.). Anal. Chem., 35: 552-4(Apr. 1963).

A quantitative radioisotopic method for distinguishing and determining neomycins B, C, and neamine (neomycin A) is presented. The procedure is based on the paper chromatographic separation of the carbon-14 N-acetyl derivatives in a system composed of 1-butanol, water, and piperidine in the ratios of 84 to 16 to 2 parts by volume, respectively. The derivatives are located by passing the chromatogram through an automatic scanner and quantitated by liquid scintillation counting. The analysis of whole beer, filtered beer, spent beer, and filter cake extracts for neomycin B content can be performed directly. The neomycin C cannot be radioassayed directly in beers because of interference from a more polar material. If, however, the beers are treated with Amberlite IRC-50 ion exchange resin, the alkaline eluates may be analyzed for neomycins B, C, and neamine. Using this modification, the method is applicable to fermentation samples and final products. (auth)

**17984** A MODIFIED CONWAY METHOD FOR DETERMINING AMMONIA IN URANIUM COMPOUNDS. C. J. G. Altmann, B. H. J. de Heer, and M. E. A. Hermans (N. V. KEMA, Arnhem, Netherlands). Anal. Chem., 35: 596-7 (Apr. 1963).

The microdiffusion method of Conway was modified for application to the determination of ammonia in uranium compounds containing other components that evolve ammonia on heating, e.g., urea. The entire determination is carried out at room temperature. Standard sulfuric acid was substituted for boric acid as the absorbing medium. (D.L.C.)

**17985** THE NATURE OF EUROPIUM ION IN CARBONATE SOLUTION AND POLAROGRAPHIC DETERMINATION OF MICRO AMOUNTS OF EUROPIUM. Seizo Misumi and Yoshitaka Masuda (Kyushu Univ., Japan). Anal. Chim. Acta, 28: 188-96(Feb. 1963). (In English)

The nature of the complex europium carbonate ion in concentrated carbonate solution was studied polarographically. A polarographic method for the determination of micro amounts of europium ion in the presence of diverse ions (and especially lanthanides) was developed. (auth)

**17986** THE USE OF THE MASS SPECTROMETER FOR THE QUANTITATIVE ANALYSES OF MIXTURES OF AMINO ACIDS. Gregor Junk and Harry Svec (Ames Lab., Ames, Iowa). Anal. Chim. Acta, 28: 164-9(1963). (IS-495)

The quantitative analysis of a low vapor pressure unstable solid mixture of amino acids is possible by putting the solid mixture in a crucible which is then placed directly into the ionization chamber of a mass spectrometer. Relative sensitivities for the various acids in a mixture can be established by the proper use of a particular amino acid as an internal calibrating standard. The success of the method depends upon: the reproducibility of the mass spectra of the pure components, the ideal vapor pressure behavior of the solid mixture, and the preparation of an intimate solid mixture by rapid freezing of the water solution of the acids with subsequent vacuum sublimation of the ice and ball-milling the dried mixture. (auth)

**17987** DETERMINATION OF SODIUM, ARSENIC, ANTIMONY AND COPPER IN CARBON BY NEUTRON-ACTIVATION ANALYSIS. Yuichiro Kamemoto and Shigeru Yamagishi (Japan Atomic Energy Research Inst., Tokyo). Bull. Chem. Soc. Japan, 36: 132-6(Feb. 1963).

Various methods of chemical separation for use in neutron activation analysis of graphite are discussed. The burning method combined with the treatment of the burning quartz boat with a $HF-HNO_3$ mixture was found best suited for the determination of Na, As, Sb, and Cu in C. The results are compared with those obtained with a nondestructive method, and it is concluded that the abnormally large value of arsenic found in the latter method is due to errors in the analysis of the decay curves. (D.L.C.)

**17988** THE SPECTROPHOTOMETRIC DETERMINATION OF URANIUM WITH XYLENOL ORANGE. Makoto Otomo (Hirosaki Univ., Japan). Bull. Chem. Soc. Japan, 36: 140-2(Feb. 1963).

A new spectrophotometric method for determining trace amounts of uranium was developed. This method is based on the coloration of xylenol orange with uranium(IV) formed by the reduction of uranium(VI) in the presence of ascorbic acid. The effects of the pH value, reagent, and boiling time were thoroughly investigated, and experimental conditions which make possible the determination of 20 to 100 $\mu$g of uranium were devised. The mole ratio of the complex between uranium and this reagent is also discussed. (auth)

**17989** FLUORIMETRIC DETERMINATION OF URANIUM TRACES. Josef Sommer (Zentralinstitut für Kernphysik, Rossendorf, Ger.). Chem. Tech. (Leipzig), 15: 38-41(Jan. 1963). (In German)

For the quantitative determination of natural uranium a fluorimeter, which works according to the reflection principle, was built. With the use of a $NaF-LiF$ mixture $5 \times 10^{-9}$ g and with the carbonate mixture $10^{-9}$ g of uranium per melt test could be detected. The mean relative apparatus error was from 1.1 to 10% of the possible galvanometer indicator deflection and the standard deviation was determined to be $\pm 1.5\%$. The additional procedures were used for the determination of uranium in urine without separation of the inorganic constituents. In the region of $2 \times 10^{-9}$ to $1.2 \times 10^{-8}$ g uranium/ml urine the average relative error amounted to 3% and the standard deviation $\pm 4\%$. (M.C.G.)

**17990** X-RAY SPECTROMETRY IN THE CLINICAL LABORATORY. VII. BROMIDE NORMALLY PRESENT IN HUMAN SERUM. Samuel Natelson, Bertrum Sheid, and Donald R. Leighton (Roosevelt Hospital, New York). Clin. Chem., 8: 630-9(Dec. 1962).

A procedure is described for estimating the Br content of human serum from individuals not receiving Br medication. Serum is ashed and dissolved in HCl. The solution is dehydrated with the calculated amount of acetic anhydride and the precipitated NaCl is washed with additional glacial acetic acid to remove Br. NaCl is removed by centrifugation and Br recovered by evaporation of acetic acid. The residue is dissolved in methanol and transferred to filter paper for assay in the x-ray spectrometer. The procedure, with the omission of ashing, is applicable to sea water. When it was applied to sea water, Sr as well as Br could be visualized on the recorder of the instrument and assayed. This is because $SrCl_2$ is soluble in glacial acetic acid, unlike NaCl. Therefore, the method also provides a means of analyzing for Sr in natural waters. An average value of 8 μg/ml was found for the Sr content of sea water, which is in the same range found by flame photometry after isolating Sr by ion-exchange chromatography. Normal human serum was found to contain a mean level of 252 μg Br per 100 ml, with a range (2 σ) of ±42 μg/100 ml. (H.H.D.)

**17991** DETERMINATION OF $Sr^{90}$ AND $Th^{228}$ IN BIOLOGICAL MATERIALS. F. W. Bruenger, D. R. Atherton, and Betsy J. Stover (Univ. of Utah, Salt Lake City). Health Phys., 9: 232-5(Feb. 1963).

Methods were developed for the analysis of dog feces for $Sr^{90}$ and $Th^{228}$. The $Sr^{90}$ determination is an adaption of the $Sr(NO_3)_2$ precipitation method to separate Sr and Ca. An initial basic precipitation separates $Sr^{90}$ from a troublesome, unidentified constituent of the samples. In the determination of $Th^{228}$, two precipitations with $H_2O_2$, first at pH 2 and then at pH 9, precede the coprecipitation of $Th^{228}$ with ceric m-nitrobenzoate. Finally, $Th^{228}$ is obtained carrier-free using an ion exchange column. (auth)

**17992** A METHOD OF IODINE DETERMINATION BY CHARACTERISTIC X-RAY ABSORPTION. O. Z. Roy (National Research Council, Ottawa), R. A. Belque and G. L. D'Ombrain. IRE (Inst. Radio Engrs.) Trans. Bio-Med. Electron., 9: 50-3(Jan. 1962).

A technique is described for the quantitative analysis of nonradioactive iodine. It makes use of x-ray absorption discontinuities for the detection of iodine in the presence of other absorbing substances. A stationary lanthanum radiator converts an x-ray beam having a continuous spectrum into 2 monochromatic beams which straddle the iodine absorption edge. The energy spread is such as to make the technique relatively independent of other foreign elements. A rotating filter alternately absorbs 1 of the 2 beams while leaving the other on continuously. The ratio of the intensities is determined every $^1/_{60}$ sec, and the iodine determination is insensitive to x-ray output, amplifier, and detector drift. The sensitivity of the system indicates an increase in the low-energy to high-energy beam ratio of 0.8% for every mg/cm² of iodine. The system is ~1000 times less sensitive to a given quantity of Presswood or aluminum than to the same quantity of iodine. Furthermore, the ratio decreases for any substance other than iodine; since iodine has an absorption edge, the high-energy beam is attenuated more than the low-energy beam, whereas the reverse is true for any other substance. (TCO)

**17993** SPECTROGRAPHIC YTTRIUM DETERMINATION IN MIXTURES OF RARE EARTH OXIDES WITH THE MEDIUM SIZE QUARTZ SPECTROGRAPH Q 24. Boguslaw Borkowski and Aleksandra Borkowska. Jena Rev., 4: 148-51(Aug. 1962). (In English)

Yttrium was determined spectrographically in mixtures of rare earth oxides using controlled spark excitation. In the ultraviolet region used, relatively strong yttrium spark lines occur. The mean error was ±2.23%. (M.C.G.)

**17994** ACTIVATION INTERFERENCES BY SELF-SHIELDING AND FLUX DEPRESSION IN ACTIVATION ANALYSIS. P. Morzek (Zentralinstitut für Kernphysik, Bereich Radiochemie, Rossendorf, Ger.). Kernenergie, 5: 839-45(Dec. 1962). (In German)

In the activation of samples in reactors, an activation interference can arise by self-shielding and flux depression. For activation analysis it is therefore necessary to know how large the maximum sample weight is so that a maximum permissible error in the reaction rate will not be exceeded. The sample weights in grams are listed in tabular form for most of the elements of the periodic system with an error of 5 or 10% in the reaction rate. (tr-auth)

**17995** BORON DETERMINATION BY ACTIVATION ANALYSIS USING THE NUCLEAR REACTION $B^{11}(p,n)C^{11}$. H. Rommel (Zentralinstitut für Kernphysik, Bereich Radiochemie, Rossendorf, Ger.). Kernenergie, 5: 859-60(Dec. 1962). (In German)

The experimental conditions for the suppression of the interfering reaction $N^{14}(p,\alpha)C^{11}$ were determined by irradiation with protons of different energies. (tr-auth)

**17996** ESTIMATION OF SMALL AMOUNTS OF SULPHATE BY PRECIPITATION WITH RADIOACTIVE BARIUM. D. Picou and J. C. Waterlow (Univ. of the West Indies, Jamaica). Nature, 197: 1103-4(Mar. 16, 1963).

In the course of work on the metabolism of sulphur amino-acids in malnourished infants, it was necessary to measure total sulfate concentration in large numbers of urine samples. By precipitating with barium chloride containing radioactive barium, and measuring the radioactivity in the precipitate, the estimation could be made on 0.1–0.5 ml urine. (C.E.S.)

**17997** RADIOCHEMICAL SEPARATIONS OF LOW-LEVEL RADIOACTIVITY. T. T. Sugihara (Clark Univ., Worcester, Mass.). Progr. Nucl. Energy, Ser. IX, 3: 1-23(1962).

A review is presented on some of the general aspects of low-level radiochemical separations. The blank and the problem of its reduction is considered. The identification of nuclides in low-level determinations is discussed. Some general rules are suggested for developing low-level procedures. Several examples of such procedures are described. A table of references against elements is included. (D.L.C.)

**17998** YTTRIUM-88 ON HIGH-ACTIVITY ZIRCONIUM-95 FALLOUT PARTICLES. A. Malvicini, M. De Bortoli, P. Gaglione, and E. Van der Stricht (Euratom, Ispra, Italy). Science, 139: 1287-8(Mar. 29, 1963).

Yttrium-88 has been identified, by gamma spectroscopy, in residues of grass samples gathered in the neighborhood of the Euratom Research Center, Ispra, Italy. The $Y^{88}$ is associated with $Zr^{95}$. (auth)

**17999** CHEMICAL PROPERTIES AND METHODS OF ANALYZING BORIDES OF TRANSITION AND RARE-

EARTH METALS. L. N. Kugai. Tr. Seminara po Zharostoikim Materialam, Akad. Nauk Ukr. SSR, Inst. Metallokeram. i Spets. Splavov, Kiev, 1960, No. 6, 45-51 (1961).

A method was developed to determine B in Ti, Zr, Nb, Ta, Cr, W, Mo, Ni, and V borides. Ni borides are decomposed with $HNO_3$, and the other borides by alkaline fusion in Fe or Ni crucibles. To separate Ti, Zr, Nb, Ta, Cr, and W, from B, $BaCO_3$ was used; Ni, Mo, and V were separated from B by extracting their diethyl dithiocarbamate complexes with chloroform. To separate Mo and V from B it is possible to employ a method in which $BaCO_3$ is precipitated in the presence of $Ca^{2+}$ or $Fe^{3+}$ ions (for Mo) and in the presence of $Fe^{3+}$ ions (for V). A method of analyzing rare earth metals is presented. A boride batch is dissolved in $HNO_3$. The rare earth elements are determined by titration with B Trilon and an arsenazo tracer; and B by the alkalimetric method after binding the rare earth element into a complex by a precise amount of B Trilon. The method of determining free B in Zr diboride is based on the different oxidizability of free B and B bound by a mixture of perhydrol and $HNO_3$. (Referativnyy Zhurnal, Metallurgiya, No. 9, 1962)

**18000** CONTROLLED POTENTIAL COULOMETER (Engineering Materials). (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). 2 drawings. (CAPE-905)

The coulometer is an analytical instrument capable of accurately determining the quantity of a reducible ionic species in a solution. The determination is made by quantitatively reducing or oxidizing the species with a direct electrode reaction at a controlled potential. The method was used in determining uranium, plutonium, europium, neptunium, and the ratio of oxygen to uranium in uranium dioxide. The coulometer cell is a glass vessel containing three electrodes. Current flows between the isolated and controlled electrodes. The purpose of the reference electrode, which does not draw current, is to sense and control the potential between the solutions and the controlled electrode. Current, due to chemical reaction, flows to an electronic integrator. The charge transferred is a measure of the quantity of ions undergoing the reaction and is indicated by a read-out device. The range of the instrument is 1 to 100 microequivalents of the sample. Circuit values are selected to reduce the possibility of oscillation in the control amplifier when used with the Hanford mercury cathode. (F.E.S.)

## Inorganic and Physical Chemistry

*Refer also to abstracts 17646, 17647, and 18682.*

**18001** (HW-SA-2645) THE ELECTROLYTIC PREPARATION OF SINGLE CRYSTALS OF URANIUM DIOXIDE. F. A. Scott and L. K. Mudge (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). June 18, 1962. Contract AT(45-1)-1350. 16p.

The parameters governing the electrolytic deposition of uranium dioxide from molten chloride salt solutions are discussed. Of the salt systems tested, the only practical ones for the growth of large crystals of $UO_2$ were LiCl–KCl (melting point at 460°C) and KCl–$PbCl_2$ (melting point at 580°C). Single crystals of $UO_2$ weighing as much as four grams were grown electrolytically, and an increase in the size of crystals obtainable can be effected through the use of purified salt baths. Benefits can also be obtained by using $UO_2$ anodes, by programming the deposition potential, and by minimizing the amount of convection in the melt. (H.G.G.)

**18002** (IS-634) A STUDY OF THE RARE EARTH METAL PROPIONATE COMPLEXES. George Stephen Paul and Jack E. Powell (Ames Lab., Ames, Iowa). Jan. 1963. Contract W-7405-eng-83. 34p.

The first two successive formation constants of the trivalent rare earth metals with the propionate ligand were determined by a potentiometric method. A comparison was made of the trends in the stability constants of the propionate ligand with the rare earth series with the trends observed for several other ligands. Attempts to explain some of the trends were summarized. (auth)

**18003** (JÜL-31-PC) ISOTOPENAUSTAUSCH ZWISCHEN WASSERSTOFF UND FLÜSSIGEM AMMONIAK IN GEGENWART HETEROGENER KATALYSATOREN. (Isotopic Exchange Between Hydrogen and Liquid Ammonia in the Presence of Heterogeneous Catalysts). R. Haul and D. Blennemann (Kernforschungsanlage. Institut für Physikalische Chemie, Jülich, Germany). Jan. 1962. 94p.

The isotopic exchange between hydrogen and liquid ammonia was investigated in the presence of a series of different catalysts at temperatures between −60 and +25°C and pressures up to 150 atm. For comparison the exchange between hydrogen and gaseous ammonia at hydrogen partial pressures of 50 torr to 1.5 atm and ammonia pressures of 25 torr up to saturation vapor pressure (8.7 atm at 20°C) was carried out. The most effective catalyst for the exchange reaction in liquid ammonia was potassium amide. The catalytic activity of $KNH_2$ was so great that even with very intensive blending the reaction rates were still limited by transport phenomena. Metals of Group 8 of the periodic system catalyzed the H–D exchange between hydrogen and liquid ammonia at temperatures to below −60°C. Their effectiveness decreased in the following order: Pt, Pd, Ni, and Fe. The rate of isotope exchange in a suspension of platinum–charcoal in liquid ammonia increased in the range of 10 to 100 g/l in proportion to the amount of catalyst used. The exchange between hydrogen and gaseous ammonia on platinum–charcoal catalyst can be described by the equation $\lambda = a \cdot P_{NH_3} \cdot P_{HD}{}^{1/2} / (b + P_{NH_3})^2$. If this is extrapolated to the saturation vapor pressure, then the value that was measured for exchange between hydrogen and liquid ammonia is obtained. (M.C.G.)

**18004** (LADC-5453) GRAPHITE–HYDROGEN–METHANE KINETICS ABOVE 1600°K. John D. Rogers and Alexander Sesonske (Los Alamos Scientific Lab., N. Mex.). [1962]. Contract [W-7405-eng-36]. 22p.

The reaction of $H_2$ and $CH_4$ with graphite above 1600°K was found to give an apparent zero order forward reaction and a one-half order back reaction based upon $CH_4$ as the only reaction product. A possible reaction mechanism involves a slow step with rearrangement on the surface followed by a fast step with two of the product species from the slow step combining to form $CH_4$. Forward rate activation energy values of 37.7 k-cal/mole and 78 k-cal/mole were obtained and were found to be strongly dependent upon the graphite used. Qualitative flow effects were observed. Pressures, of the order of tens of atm., were used. (auth)

**18005** (TID-16645) THE ATTEMPTED PREPARATION OF $AmF_6$. Shigeo Tsujimura, Donald Cohen, Cedric L. Chernick (Argonne National Lab., Ill.); and Bernard Weinstock (Ford Motor Co., Dearborn, Mich.). June 1962. Contract [W-31-109-eng-38]. 5p. (UAC-6548)

Experiments in which unsuccessful attempts were made

to prepare $AmF_6$ are described. It is noted that these experiments provide further evidence of the nonexistence of $AmF_6$. (J.R.D.)

**18006** (TID-16696) THE ION ACTIVITY FUNCTION—AN APPROACH TO THE STUDY OF ELECTROLYTE BEHAVIOR IN CONCENTRATED SOLUTIONS. I. THE SYSTEMS $LiCl-H_2O$ AND $LiBr-H_2O$. Erik Hoegfeldt and Leslie Leifer (Massachusetts Inst. of Tech., Cambridge). [Sept. 13, 1962]. Contract [AT(30-1)-905]. 16p.

A new approach to behavior in concentrated electrolytes is presented. The fact that a unique ion activity function was obtained for $H_3O^+$ in several strong acids was used to calculate ion activity and ion activity coefficient functions for the ions in the systems $LiCl-H_2O$ and $LiBr-H_2O$ over a wide composition range. The results indicate that free $Li^+$ carries about three water molecules even in the most concentrated solutions and $Cl^-$ and $Br^-$ are unhydrated in the region ~12 molal–saturation. The decrease in ion activity functions (seen in the highest concentrations of the salt solutions) is interpreted as due to ion-pair formation. It is assumed that the ion activity coefficient function of $Cl^-$ and $Br^-$ would be constant in the high salt concentration if no ion-pairing occurred and deviations allow one to calculate approximate values for the degree of dissociation, $\alpha$, of the ion pair. (auth)

**18007** (TID-16744) THERMOPHYSICAL PROPERTIES OF THE LANTHANIDE OXIDES. III. HEAT CAPACITIES, THERMODYNAMIC PROPERTIES AND SOME ENERGY LEVELS OF DYSPROSIUM(III), HOLMIUM(III), AND ERBIUM(III) OXIDES. Edgar F. Westrum, Jr. and Bruce H. Justice (Michigan. Univ., Ann Arbor. Dept. of Chemistry). [1962]. Contract [AT(11-1)-1149]. 32p.

Heat capacities of 3 C-type lanthanide oxides were resolved into lattice contributions and electronic Schottky-type anomalies. Low-lying crystalline field levels were delineated from these data. The lattice contributions were evaluated from the ytterbium(III) oxide and gadolinium(III) oxide heat capacities. Enthalpy increments ($\underline{H}^0-\underline{H}^0_{10}$) at 298.15°K were evaluated from the measurements as 5025, 5009, and 4779 calories $(g.f.w.)^{-1}$ for $Dy_2O_3$, $Ho_2O_3$, and $Er_2O_3$. By estimation of the remaining electronic entropy and the extrapolated lattice constant below 10°K, practical entropies ($\underline{S}^0$) at 298.15°K were evaluated as 35.8, 37.8, and 36.6 cal $(g.f.w.°K)^{-1}$. (auth)

**18008** (TID-18276) INFRARED SPECTRA OF XENON COMPOUNDS. D. F. Smith (Oak Ridge Gaseous Diffusion Plant, Tenn.). [Mar. 25, 1963]. Contract [W-7405-eng-26]. 9p.

A review of the characteristics of $XeF_2$, $XeF_4$, $XeF_6$, $XeOF_4$, and $XeO_3$ based on infrared spectra and other evidence is presented. (J.R.D.)

**18009** (TID-18398) SOME CONSEQUENCES OF THE RULE FOR THE CALCULATION OF ACTIVITY COEFFICIENTS OF SALTS IN ORGANIC SOLVENT-WATER MIXTURES. Herbert S. Harned (Yale Univ., New Haven). [1962]. Contract [AT(30-1)-1349]. 5p.

By employing the Gibbs-Duhem equation and the rule of invariance of activity coefficient ratios of salts in organic solvent-water mixtures, the restrictions imposed upon the activity ratios of the solvents are revealed. The effects of the application of this rule upon the relative partial molal heat contents and specific heats of the electrolytes are described. (auth)

**18010** (TID-18399) THE THERMODYNAMIC PROPERTIES OF THE SYSTEM: HYDROCHLORIC ACID, LITHIUM CHLORIDE AND WATER FROM 15 TO 35°. Herbert S. Harned (Yale Univ., New Haven). [196?]. Contract AT(30-1)-1349. 7p.

Parameters of the linear equation by which the activity coefficient of hydrochloric acid in lithium chloride solutions from 15 to 35° and from 0.5 to 4$\underline{M}$ were tabulated. From these data and the known properties of systems of this kind, the parameters of a similar equation for the activity coefficient of the salt were obtained. The excess heat of mixing at 1$\underline{M}$ computed from these results agrees satisfactorily with the calorimetric value. (auth)

**18011** (TID-18423) KINETICS AND MECHANISMS OF CATALYTIC REDUCTION PROCESSES. Final Terminal Report. Max S. Peters (Illinois. Univ., Urbana. Engineering Experiment Station). Mar. 15, 1963. Contract AT(11-1)-883. 13p.

Studies were made of the nature of catalysts, reactants, and extraneous material in catalytic reduction reactions. An investigation was made of the decomposition of nitric oxide on an aluminum oxide catalyst. The resulting rate of decomposition was correlated for all runs as a function of nitric oxide concentration. The mechanism suggested is the reaction of two nitric oxide molecules, absorbed on adjacent single sites as the slow step, with nitrogen and nitric oxide in equilibrium between gas and adsorbed phases. On prolonged heating of the aluminum oxide at 742°C, the catalyst activity decreased. The kinetics of dehydrogenation of methylcyclohexane to toluene on a chromia–alumina catalyst were studied at atmospheric pressure in the temperature range 380 to 480°C. The catalyst exhibited reversibly unstable activity in the temperature range 380 to 420°C. At 420°C and above the activity remained stable. It was concluded that the rate of formation of toluene was controlled by the rate of surface reaction of methylcyclohexane adsorbed on a single site and that the rate was retarded by the presence of hydrogen. A flow reactor, operated differentially at atmospheric pressure, was used to study the catalytic reduction to nitric oxide by hydrogen and by methane at temperatures of 375 to 800°C. The catalyst used was oxides of copper, zinc, and chromium. Both reduction to nitrogen and reduction to ammonia were studied. The kinetics of the dehydrogenation of isopropanol to acetone on a zinc oxide catalyst at atmospheric pressure and in the temperature range of 271 to 316°C using a tubular flow reactor was studied. Results showed that the rate-controlling step of the reaction is either single or dual site surface reaction rate. (M.C.G.)

**18012** (TID-18440) AN INVESTIGATION OF COMPLEX IONS IN FUSED SALT MEDIA. Progress Report. Ronald A. Bailey (Rensselaer Polytechnic Inst., Troy, N. Y.). Apr. 1963. Contract [AT(30-1)-2787. 5p.

A study is being made of the ions of Ti, Zr, and Hf in molten LiCl–KCl eutectic. Redox potentials for the systems Ti(0)–Ti(II), Ti(II)–Ti(III), and Zr(0)–Zr(II) were measured and temperature coefficients determined. Polarography was applied to the titanium and zirconium systems. Anodic polarization enabled the Ti(II)–Ti(III) and Ti(III)–Ti(IV) waves to be detected. The zirconium system was more difficult, apparently because Zr(III) is unstable under the conditions employed. Studies on the corrosion of titanium and zirconium metals in this molten salt were extended. Solubility measurements of the free metals and their oxides showed that they are all insoluble within the limits of detection. (auth)

**18013** (NP-tr-961) PLUTONIUM—ITS CHEMICAL AND PHYSICAL PROPERTIES. Ansgar Schiffers. Translated by E. Towndrow (U.K.A.E.A. Atomic Energy Re-

search Establishment, Harwell, Berks, Eng.) from Chemiker Z., 86: 656-70(1962). 69p.

Plutonium was first isolated by Cunningham and Werner in 1942. The development of this element during its 20-year history is discussed in detail. A detailed presentation of the physical and chemical properties of plutonium with its applications and potentials are presented. (H.G.G.)

**18014** (SCL-T-467) VAPOR DIFFUSION IN CAPILLARIES. N. N. Fedyakin. Translated by Marcel I. Weinreich (Sandia Corp., Albuquerque, N. Mex.) from Izv. Vysshikh Uchebn, Zavedenii, Fiz., No. 3, 82-92(1962). 20p.

The diffusion coefficient of vapors in capillaries remains constant as long as the diameter of the capillary is > the mean free path length. The diffusion coefficient is directly proportional to the capillary's radius and to the mean velocity of the molecular movement when the capillary's radius is < the length of the mean free path. A theoretical dependence of the diffusion coefficient on the capillary's radius and on the length of the mean free path of the molecules was obtained, and a comparison with the results of experimental measurements was made. The agreement between theory and empiricism is satisfactory in this case. (auth)

**18015** (SCL-T-472) THE QUESTION OF BONDING IN THE RARE EARTH HYDRIDES. K. Dialer. Translated by Marcel I. Weinreich (Sandia Corp., Albuquerque, N. Mex.) from Monatsh. Chem., 79: 311-15(1948). 7p.

The rare earth hydrides are energetically on the same level as the alkaline-earth metals, which belong to the saline hydrides and hydrogen compounds of metallic earth alkalis. A study on the system of Cer mixed metal-hydrogen shows that the assumption of a partially polar bonding in the rare earth hydrides is compatible with previous investigation results. The different behavior during the activation of the third valence is explained by the fact that the valence electrons belong to different shells, whereby an additional role is attributed to an influence by the already present hydrogen atoms. (H.G.G.)

**18016** (UCRL-Trans-903(L)) SOLUTIONS OF ALKALI METALS IN LIQUID AMMONIA. NOTE VII. THE ELECTRON STRUCTURE OF THE SPECIES PRESENT IN SODIUM SOLUTIONS. Leonello Paoloni. Translated by M. S. Little (Univ. of California Lawrence Radiation Lab., Livermore) from Gazz. Chim. Ital., 91: 1063-84(1961). 42p. (Includes original, 22p.).

It is shown that in the formation of the monomeric structure by coordination of three $NH_3$ ions around the neutral Na atom the repulsive energy between like ions is counterbalanced by the energy of the coordination bonds and by the promotion of the metal electron to excited levels. It is also demonstrated that examination of the electron structure of the dimer and the solvate can be restricted to study of the two electrons which effect the Na–Na coupling. The electron structure of the dimer corresponds to the meeting of the two monomers with face-to-face orientation, at a distance of about 8 Å, while the structure of the solvate indicates a probable Na–Na separation of about 4Å. (J.R.D.)

**18017** (UCRL-Trans-938(L)) ACTION OF HYDROGEN PEROXIDE ON TRIVALENT AND TETRAVALENT PLUTONIUM IN HYDROCHLORIC ACID SOLUTION. A. S. Ghosh Mazumder, P. V. Balakrishnan, and R. N. Singh. Translated for Univ. of California Lawrence Radiation Lab., Livermore from Vijnana Parishad Anusandhan Patrika, 4: 149-60(1961). 25p. (Includes original, 12p.).

The action of $H_2O_2$ on the Pu(IV)/Pu(III) system is described. The ratio of Pu(IV) to Pu(III) in such a system depends on the H and Cl ion concentrations and on the Pu concentrations. These relations are studied by means of a microtitrimetic method for estimating Pu(III) and $H_2O_2$ in the presence of each other in HCl. Experimental data are included. (J.R.D.)

**18018** STUDIES ON THE PRECIPITATION OF AMMONIUM URANATES. III. REACTIONS OF URANYL PERCHLORATE AND ACETATE WITH AMMONIA. C. Drăgulescu and I. Julean. Acad. Rep. Populare Romine, Baza Cercetari Stiint. Timisoara, Studii Cercetari, Stiinte Chim., 9: 71-9(1962). (In Romanian)

The reactions of uranyl perchlorate and uranyl acetate with ammonia were studied using potentiometric, conductometric, and analytical methods. In the uranyl perchlorate reaction, a polyuranate $(NH_4)_2O \cdot 8UO_3$ is first separated. With ammonia excess this polyuranate is transformed into the tetrauranate $(HN_4)_2O \cdot 4UO_3$. The corresponding compounds separated from the reaction of uranyl acetate with ammonia are $(NH_4)_2O \cdot 6UO_3$ and $(NH_4)_2 \cdot 4UO_3$. It was possible to separate the ammonium mono or diuranates. (tr-auth)

**18019** STUDIES ON THE PRECIPITATION OF AMMONIUM URANATES. IV. REACTION OF URANYL NITRATE AND ACETATE WITH ALIPHATIC AMINES. C. Drăgulescu and I. Julean. Acad. Rep. Populare Romine, Baza Cercetari Stiint. Timisoara, Studii Cercetari, Stiinte Chim., 9: 81-90(1962). (In Romainian)

The reactions of uranyl nitrate and uranyl acetate with different aliphatic amines were studied by potentiometric, conductometric, and analytical methods. The results obtained show that all the amines form tetrauranates $(AmH)_2O \cdot 4UO_3$. During the reaction polyuranates are also formed. Their composition depends on the salt from which they originate and on the amine utilized. The more basic polyuranates are obtained from complex uranyl salts with amines with the smallest molecular volume. The following polyuranates were synthesized: $(AmH)_2O \cdot 4UO_3 \cdot \underline{n}H_2O$ (where Am = methyl-, dimethyl-, trimethyl-, and diethylamine), $(AmH)_2O \cdot 8UO_3 \cdot \underline{n}H_2O$ (where Am = methyl-, dimethyl-, and trimethylamine), $(AmH)_2O \cdot 12UO_3 \cdot \underline{n}H_2O$ (where Am = methylamine), and $(AmH)_2O \cdot 16UO_3 \cdot \underline{n}H_2O$ (where Am = dimethyl-, and triethylamine). The compound $(AmH)_2O \cdot 40\ UO_3$ synthesized in the reaction with diethylamine can be considered as $UO_3 \cdot \underline{n}H_2O$. (tr-auth)

**18020** PREPARATION BY SOLID STATE REACTION AND STRUCTURES OF ZIRCONIUM OXYNITRIDES. Jean-Claude Gilles (CNRS, Vitry-sur Seine, France). Bull. Soc. Chim. France, No. 11-12, 2118-22(Nov.-Dec. 1962). (In French)

The various zirconium oxynitrides formed by the action of ammonium on zirconia were prepared by solid state reactions between $ZrO_2$ and ZrN in the same ammonia atmosphere and at the same temperatures. The structure of the zirconium oxynitrides is derived from the fluorine-type structure of the zirconia. (tr-auth)

**18021** STUDIES ON PROTACTINIUM PEROXIDE. I. STUDY OF THE CONDITIONS FOR THE FORMATION OF PROTACTINIUM PEROXIDE IN DIFFERENT AQUEOUS MEDIA. Tatiana Stchouzkoy and Roland Muxart (Institut du Radium, Arcueil, France). Bull. Soc. Chim. France, No. 11-12, 2176-81(Nov.-Dec. 1962). (In French)

The conditions for the precipitation of the protactinium peroxide formed in sulfuric, nitric, hydrochloric, or perchloric media by the action of hydrogen peroxide were studied systematically as a function of the concentration

of the reagents, concentration of the element, and temperature. The results obtained are compared with data from the literature on the peroxides of neighboring elements. (tr-auth)

**18022** EFFECT OF THERMAL AND MECHANICAL TREATMENT OF THE KINETICS OF ANODIC ATTACK OF AN ALUMINUM–MAGNESIUM ALLOY WITH 5.5% MAGNESIUM. Jean Amosse (Laboratoire Physique des Métaux, S.T.C.A.N., Paris). Compt. Rend., 256: 937-9(Jan. 21, 1963). (In French)

The modifications caused by thermal and mechanical treatment to the kinetic parameters of anodic polarization were studied for an Al–Mg alloy with 5.5% Mg. The preparation of the samples and the experimental techniques are described. A sudden quenching causes a considerable increase in the speed of the anodic attack, and cold working decreases the slope of the polarization curve. A possible mechanism for the effects observed is discussed. (J.S.R.)

**18023** TELLURIDES OF THE RARE EARTH ELEMENTS WITH THE GENERAL FORMULA $MTe_2$. Marie Paule Pardo, Jean Flahaut, and Louis Domange. Compt. Rend., 256: 953-5(Jan. 21, 1963). (In French)

A study was made to determine the existence of homogeneous ranges in the vicinity of the theoretical formula of $MTe_2$, where M is La, Ce, Pr, Nd, Sa, Gd, and Dy. The tellurides were prepared by direct union of the elements in pyrex ampules sealed under vacuum and heated for 10 days at 550°C. The x-ray diagrams of all the products are similar and can be interpreted in the quadratic system with intensities characteristic of the $FeAs_2$ or PbFCl type. The crystallographic parameters were determined from one end to the other of the homogeneous ranges. (J.S.R.)

**18024** ON THE SYNTHESIS OF $XeF_6$. J. Slivnik, B. Brčić, B. Volavšek, J. Marsel, V. Vrščaj, A. Šmalc, B. Frlec, and Z. Zemljič (Nuclear Institute "Jožef Stefan", Ljubljana, Yugoslavia). Croat. Chem. Acta, 34: 253(1962). (In German)

An attempt was made to fluorinate Xe with the purest fluorine in excess at 700°C and approximately 200 atm. The product was cooled to –78°C and the excess $F_2$ pumped out. The residue was sublimed in vacuum. The first fraction melted at 25°C to a pale yellow liquid. It was stable under vacuum in glass ampules, but exploded very violently in air or under impact. Analysis showed the F/Xe ratio to be 6.1 ± 0.3, corresponding to a composition of $XeF_6$. Mass spectrometric studies confirmed this composition. (J.S.R.)

**18025** ELECTRIC PROPERTIES OF URANIUM OXIDES FROM $U_3O_8$–$UO_2$. V. M. Zhukovskii, V. G. Vlasov, and A. G. Lebedev (Kirov Polytechnic Inst., USSR). Fiz. Metal. i Metalloved., 14: 319-20(Aug. 1962). (In Russian)

Studies of electric conductivity of oxides from $U_3O_8$ to $UO_2$ at 25 to 600°C showed that the conductivity increases with temperature and can be expressed by the equation $\chi = A \exp(-\Delta E/2kT)$. Removal of oxygen from the lattices of $UO_{2.67}$ to $UO_{2.56}$ increases the conductivity by an order of magnitude. The crystal structures from $UO_2$ to $U_4O_9$ are similar, but the density of $U_4O_9$ is higher. The conductivity measurements confirmed the formation of $U_3O_8$, $U_3O_{8-x}$, $U_4O_9$, $UO_{2+x}$, and $UO_2$. (R.V.J.)

**18026** ELECTRIC CONDUCTIVITY OF URANIUM–OXYGEN OF $UO_3$–$U_3O_8$ COMPOSITION. V. M. Zhukovskii, V. G. Vlasov, and A. G. Lebedev (Ural Polytechnic Inst., USSR). Fiz. Metal. i Metalloved., 14: 475-8(Sept. 1962). (In Russian)

Electric conductivity of uranium–oxygen systems with compositions $UO_3$ to $U_3O_8$ was studied at 25 to 200°C. The tests were made using 14.5-mm diameter, 7-mm thick compressed specimens of 3.0 g/cm$^3$ ($UO_3$) to 3.65 g/cm$^3$ ($U_3O_8$). A d-c megohmmeter was used for measuring the resistances between $10^6$ and $10^{11}$ ohms, and an a-c oscillograph was used between $10^{-1}$ and $10^{-6}$ ohms. The obtained data on specific electric conductivity of $UO_3$ to $UO_{2.67}$ indicated a transition from the less ordered $UO_3$ to the more ordered $U_3O_8$. (R.V.J.)

**18027** REACTION OF URANIUM WITH NITROGEN. A. F. Bessonov and V. G. Vlasov. Fiz. Metal i Metalloved., 14: 478-9(Sept. 1962). (In Russian)

Studies of U reactions with nitrogen at 400 to 920°C and 200 mm Hg nitrogen pressure indicated no nitriding below 400°. The reaction rate at 590 and 710°C and 20 to 600 mm Hg pressure is directly proportional to the square root of the pressure and is not influenced by nitrogen circulation. The similarity of the obtained data with data on U oxidation by air suggested a nitriding mechanism in which a dense nitride layer appears under a $UO_2$ film produced in preliminary treatment. Then the $UO_2$ layer separates from nonoxidized metal and cracks while the dense nitride layer grows into a porous, cracked surface. (R.V.J.)

**18028** ISOTHERMAL DEHYDRATION OF URANIUM(IV) OXYOXALATE HEXAHYDRATE. Balaram Sahoo (Maharaja Purna Chandra Coll., Baripada, India). Indian J. Chem., 1: 137(1963).

The tetra- and monohydrate forms of uranium(IV) oxyoxalate were prepared by isothermal dehydration processes. The tetrahydrate was obtained when the uranium(IV) oxyoxalate hexahydrate, $UO(C_2O_4) \cdot 6H_2O$, was allowed to dehydrate in vacuum at 30°C for about 48 hr, while the monohydrate was obtained by heating the compound in vacuum at 150°C for 3 to 4 hr. (auth)

**18029** STEREOCHEMISTRY OF DISCRETE EIGHT-COÖRDINATION. I. BASIC ANALYSIS. J. L. Hoard and J. V. Silverton (Cornell Univ., Ithaca, N. Y.). Inorg. Chem., 2: 235-43(Apr. 1963).

An ordered pattern having useful predictive capacity for discrete eight-coördination was obtained by interweaving helpful bits of theory with accurate stereochemical data from x-ray studies utilizing full three-dimensional analysis. The most sweeping conclusion of this phenomenological theory was that the energetics of direct bonding interaction must differ so little for the dodecahedral ($Mo(CN)_8^{-4}$-type) and square antiprismatic configurations that the choice between them is determined, usually or always, by other factors. The detailed shape of the coördination group of a real complex is never that of the hard sphere model, but is rather that which makes the ligand repulsive energy from closed-shell interactions a (constrained) minimum; the most favorable dodecahedral and antiprismatic shapes accomplish this equally well. For a tetrakis-bidentate chelate it appears that differences in the closed-shell repulsive energy for competing stereoisomers may run easily to 5 kcal/mole and that minimization of internal coulombic repulsions takes precedence when the complex is charged. Stereoisomerism in the M(IV) $\beta$-diketo chelates, $M(X_2)_4$, is discussed in detail. Increasing complication, e.g., mixing of ligands, multidentate character, usually is better served by dodecahedral coördination. The $Mo(CN)_8^{-4}$ ion receives special attention. (auth)

**18030** STEREOCHEMISTRY OF DISCRETE EIGHT-COÖRDINATION. II. THE CRYSTAL AND MOLECULAR STRUCTURE OF ZIRCONIUM(IV) ACETYLACETONATE.

J. V. Silverton and J. L. Hoard (Cornell Univ., Ithaca, N. Y.). Inorg. Chem., 2: 243-9(Apr. 1963).

Three-dimensional {hkl} x-ray data measured for $0 < (\sin\theta)/\lambda < 0.76$ from monoclinic crystals of zirconium(IV) tetrakisacetylacetonate lead to definitive structure determination. The quasi-symmetry of the square antiprismatic coördination group, as also of the complete molecule, is very nearly $D_2$-222, the maximum for the stereoisomeric type. Deviations from $D_2$ symmetry having probable significance are limited to the weakest links, the complexing Zr–O bonds. The dimensional integrity of the rings, extending to virtual equivalence of chemically similar bonds, is maintained in all other respects. The bond data compare favorably with a composite of the more accurate results reported by others for simpler materials. The observed lengthening, on the average, of lateral edges relative to those of square faces in the coördination group is in accord with the a priori analysis of HS; a significant further distortion, taken in accord with $D_2$, is in the direction of the dodecahedral stereoisomer mmmm of HS. (auth)

**18031** STEREOCHEMISTRY OF DISCRETE EIGHT-COÖRDINATION. III. TETRASODIUM TETRAKISOXALATOZIRCONATE(IV) TRIHYDRATE. G. L. Glen, J. V. Silverton, and J. L. Hoard (Cornell Univ., Ithaca, N. Y.). Inorg. Chem., 2: 250-6(Apr. 1963).

Three-dimensional {hkl} x-ray data in the range $0 < (\sin\theta)/\lambda < 0.95$ from orthorhombic crystals of $Na_4Zr(C_2O_4)_4 \cdot 3H_2O$ yielded a definitive determination of structure. The tetrakisoxalatozirconate(IV) ion, required by the space group ($B22_12$) to have a single two-fold axis, belongs in fact to the dodecahedral ($Mo(CN)_8^{-4}$) stereoisometic type having $D_{2d}$-$\bar{4}2m$ ideal symmetry. The complicated crystalline arrangement was determined primarily by direct interaction of sodium ions with oxalato oxygen (water molecules were relegated to the role of filler). The $Zr(C_2O_4)_4^{-4}$ ion departed significantly from $\bar{4}2m$ symmetry. This distortion was limited, well within the probable experimental accuracy, to the inner coördination group, i.e., to the chemically least stable and structurally least rigid part of the complex. The structurally non-equivalent oxalato rings were flat and, barring some variation in Zr–O bond lengths, were virtually isodimensional. Bond parameters, including an averaged Zr–O bond length of 2.199 Å, were in excellent agreement with a composite of other reported data. A structurally significant difference of 0.06 Å between averaged bond lengths for $Zr-O_A$ and $Zr-O_B$ types (cf., HS) overlay the distortion of the inner coördination group. (auth)

**18032** AMIDES AS LIGANDS. I. METALLIC COMPLEXES OF N,N-DIMETHYLACETAMIDE. William E. Bull, Stanley K. Madan, and Joseph E. Willis (Univ. of Tennessee, Knoxville and Harpur Coll., Binghamton, N. Y.). Inorg. Chem., 2: 303-6(Apr. 1963).

The preparation of 26 metallic complexes of 14 different metals with N,N-dimethylacetamide (DMA) is reported. The complexes were characterized by their melting points, infrared spectra in the 2 to 15 $\mu$ region, electrical conductance in DMA, and magnetic moments. The infrared spectra suggest that coördination through the oxygen of DMA occurs for all the metals investigated. In most instances, the complexes contain fewer moles of DMA than the maximum coördination number of the metal, indicating coördination by halide ion and/or water. (auth)

**18033** PARTIAL IONIC CHARACTER OF METAL–CHLORINE BONDS. Ralph G. Pearson and Harry B. Gray (Northwestern Univ., Evanston, Ill.). Inorg. Chem., 2: 358-63(Apr. 1963).

Several ionic models for bonding in metallic chlorides were tested. These included the hard sphere ion model, the polarizable sphere, and a localized molecular orbital model with partial covalent bonding. These van der Waals' repulsions were included. All integrals were evaluated from experimental data. In the MO model the coulomb integrals were considered as functions of x, the fractional "ionic character" of each bond. Binding energies could be calculated about equally well by either the covalent bonding or polarization approach. It seemed feasible to develop a semi-empirical MO method in inorganic chemistry for both absolute (binding) energies and relative (spectroscopic) energies. The best value of x was found for each system and the resulting ionicities of 50 to 90% appeared reasonable. Other criteria for x such as the equalization of electronegativities and the principle of electroneutrality were criticized. (auth)

**18034** MONOGERMANES—THEIR SYNTHESIS AND PROPERTIES. James E. Griffiths (Bell Telephone Labs., Inc., Murray Hill, N. J.). Inorg. Chem., 2: 375-7(Apr. 1963).

Germane and the methylgermanes $CH_3GeH_3$, $CD_3GeH_3$, $(CH_3)_2GeH_2$, $(CD_3)_2GeH_2$, and $(CH_3)_3GeH$ were prepared by the addition of an aqueous solution of sodium hydroborate to acidic solutions of $GeO_2$, $CH_3GeBr_3$, $CD_3GeBr_3$, $(CH_3)_2GeBr_2$, $(CD_3)_2GeBr_2$, and $(CH_3)_3GeBr$, respectively. At reaction temperatures of 30 to 55°C, yields of 94 to 100% were obtained for the alkylgermanes and no side reactions were noticed. Physical properties of the $CH_3$ derivatives are reported. The yield of germane was virtually quantitative and temperature-independent in the 0 to 80°C range. (auth)

**18035** INFRARED SPECTRA OF METAL CHELATE COMPOUNDS OF HEXAFLUOROACETYLACETONE. Melvin L. Morris, Ross W. Moshier, and Robert E. Sievers (Aerospace Medical Research Labs. and Aeronautical Research Labs., Wright-Patterson AFB, Ohio). Inorg. Chem., 2: 411-12(Apr. 1963).

The infrared spectra of metal chelate compounds of hexafluoroacetylacetone were determined. The metals were Rh, Cr, Fe, Al, Th, Ni, Co, Nd, Zn, Mn, Fe, Zr, and Cu. Melting points were also measured. The complexes were prepared by two methods: addition of an aqueous solution of the neutralized ligand to an aqueous solution of the cation and addition of the ligand directly to a suspension of the anhydrous metal chloride in carbon tetrachloride. (M.C.G.)

**18036** ON THE EXISTENCE OF ERBIUM, THULIUM, AND LUTETIUM HEXABORIDES. George D. Sturgeon and Harry A. Eick (Michigan State Univ., East Lansing). Inorg. Chem., 2: 430-1(Apr. 1963). (TID-17496)

Attempts were made to prepare hexaborides of erbium, thulium, and lutetium. The sesquioxides were mixed with boron carbide, formed into pellets, and heated at temperatures between 1100 and 1600°C. The predominant phase in the products of the complete reactions was the tetraboride, but, in addition, the face-centered cubic phase of the dodecaboride of the respective metal was observed. In no case was even a trace of a cubic hexaboride phase detected. (M.C.G.)

**18037** A FAR-ULTRAVIOLET SPECTROSCOPIC STUDY OF XENON DIFLUORIDE. E. Guy Wilson, Joshua Jortner, and Stuart A. Rice (Univ. of Chicago). J. Am. Chem. Soc., 85: 813-14(Mar. 20, 1963).

The absorption spectrum of $XeF_2$ in the gas phase was studied in the uv region to 1100 Å. A weak band was found at 2300 Å, while strong absorption at 1580 Å was observed, followed by sharp bands at 1425, 1335, 1215, and 1145 Å. The results are interpreted in terms of the binding in $XeF_2$. The strong 1580 Å absorption is assigned to the first singlet-singlet allowed transition $\sigma_g \rightarrow \sigma_u^+$. The weak 2300 Å band probably arises from a singlet-singlet transition $\pi_u \rightarrow \sigma_u^+$. The sharp bands are assigned to Rydberg states, and the first ionization potential is calculated to be 11.5 ± 0.2 ev. (D.L.C.)

**18038** THE HEATS OF SUBLIMATION OF $XeF_2$ AND $XeF_4$ AND A CONJECTURE ON BONDING IN THE SOLIDS. Joshua Jortner, E. Guy Wilson, and Stuart A. Rice (Univ. of Chicago). J. Am. Chem. Soc., 85: 814-15(Mar. 20, 1963).

The heats of sublimation ($\Delta H_{sub}$) were determined by measuring the temperature dependence of the vacuum uv absorption bands of the gas in thermal equilibrium with the crystals. A Clausius-Clayperon plot of the data gives the following values of $\Delta H_{sub}$: $XeF_2$, 12.3 ± 0.2 kcal/mole; $XeF_4$, 15.3 ± 0.2 kcal/mole. The interpretation of these large $\Delta H_{sub}$ values is considered, and it is concluded that the dominant contribution to the stability of $XeF_2$ and $XeF_4$ arises from electrostatic interactions. The discrepancy in the Xe–F bond length of $XeF_2$ estimated from the separation of the unresolved infrared P and R branches and that calculated from x-ray data, is considered briefly. (D.L.C.)

**18039** A FAR-ULTRAVIOLET SPECTROSCOPIC STUDY OF XENON TETRAFLUORIDE. J. Jortner, E. G. Wilson, and S. A. Rice (Univ. of Chicago). J. Am. Chem. Soc., 85: 815-16(Mar. 20, 1963).

The absorption spectrum of gaseous $XeF_4$ was studied in the uv region to 1100 Å. A weak band appeared at 2265 Å, followed by two strong bands at 1840 and 1325 Å. M. O. orbitals relevant to the interpretation of the spectrum are given. The weak 2265 Å band is assigned to the forbidden $a_{2u} \rightarrow e_u^+$ transition. The strong 1850 and 1325 Å bands are assigned to the allowed x, y polarized $b_{1g} \rightarrow e_u^+$ and $a_{1g} \rightarrow e_u^+$ transitions, respectively. (D.L.C.)

**18040** XENON TRIOXIDE. D. F. Smith (Oak Ridge Gaseous Diffusion Plant, Tenn.). J. Am. Chem. Soc., 85: 816-17(Mar. 20, 1963). (TID-17561)

The preparation of the explosive compound $XeO_3$ by slow hydrolysis of $XeF_6$ is described. Neutron activation analysis and infrared spectra show no fluorine in $XeO_3$. The decomposition reaction is found to be $XeO_3 \rightarrow Xe + {}^3/_2\ O_2$, with small amounts of $CO_2$ due to reaction of $O_2$ with carbon-containing material. The deliquescence behavior of $XeO_3$ at high humidities is described briefly. (D.L.C.)

**18041** CRYSTAL AND MOLECULAR STRUCTURE OF XENON TRIOXIDE. David H. Templeton, Allan Zalkin, J. D. Forrester, and Stanley M. Williamson (Univ. of California, Berkeley). J. Am. Chem. Soc., 85: 817(Mar. 20, 1963). (UCRL-10661)

The chemical formula of $XeO_3$ was confirmed by adding KI to an acidified aqueous solution of $XeO_3$ and measuring the liberated iodine and xenon. Crystal data were obtained from oscillation and Weissenberg x-ray-diffraction photographs. The orthorhombic unit cell has the dimensions a = 6.163 ± 0.008, b = 8.115 ± 0.010, c = 5.234 ± 0.008 Å. The Xe–O bond distances are 1.74, 1.76, and 1.77 ± 0.03 Å. The O–Xe–O bond angles are 108, 100, and 101 ± 2°. (D.L.C.)

**18042** A SYNTHESIS OF XENON DIFLUORIDE NOT INVOLVING USE OF ELEMENTAL FLUORINE. Dolphus E. Milligan and D. Richard Sears (Mellon Inst., Pittsburgh). J. Am. Chem. Soc., 85: 823(Mar. 20, 1963).

The successful synthesis of $XeF_2$ by high-voltage discharge in equimolar mixtures of Xe and $CF_4$ is reported. The experimental apparatus and the results of a typical run are described. Mass spectrographic analysis confirmed the formula, and the infrared spectrum of the gaseous $XeF_2$ was measured. (D.L.C.)

**18043** THE BONDING IN THE INERT GAS–HALOGEN COMPOUNDS — THE LIKELY EXISTENCE OF HELIUM DIFLUORIDE. George C. Pimentel and Richard D. Spratley (Univ. of California, Berkeley). J. Am. Chem. Soc., 85: 826-7(Mar. 20, 1963).

Pimentel's molecular orbital description of trihalides is discussed with respect to its application to inert gas–halogen complexes. The vibrational frequencies and force constants of $HeF_2$ are predicted from these of $HF_2^-$. (D.L.C.)

**18044** TETRAHEDRAL $NiCl_4^{2-}$ IN MOLTEN SALTS. THE COMPLETE SPIN-ALLOWED SPECTRUM OF 3d ORBITAL TRANSITIONS. Charles R. Boston and G. Pedro Smith (Oak Ridge National Lab., Tenn.). J. Am. Chem. Soc., 85: 1006-7(Apr. 5, 1963).

The $NiCl_4^{2-}$ spectrum was observed for solutions of $NiCl_2$ in CsCl and KCl melts at high temperatures, and the spectrum in CsCl at 680° is graphically shown. The results fit the Liehr and Ballhausen calculations for the three transitions $^3T_1(F) \rightarrow {}^3T_2(F)$, $^3A_2(F)$, $^3T_1(P)$ with a Dq of ~370 $cm^{-1}$. The use of the $^3T_1(F) \rightarrow {}^3T_2(F)$ transition for the identification of tetrahedral nickel(II) complexes in molten salts is discussed. It is concluded that the complex is tetrahedral. (D.L.C.)

**18045** HYDROGEN–HELIUM ION-MOLECULE REACTIONS. Helge von Koch and Lewis Friedman (Brookhaven National Lab., Upton, N. Y.). J. Chem. Phys., 38: 1115-22(Mar. 1, 1963). (BNL 6479)

The reactions producing $HeH^+$ from gaseous mixtures of $H_2$ and He subjected to electron impact in the ion source of a mass spectrometer were studied. Ionization efficiency curves show practically all of the $HeH^+$ to be formed by reaction of $H_2^+$ and He. Phenomenological cross sections were compared with values for the formation of $H_3^+$ from the $H_2^+ - H_2$ present in the ion source. The maximum value of the ratio of rate constants for $HeH^+$ and $H_2^+$ formation computed from the experimental data was 28% of the theoretical ratio. If the heat of the endothermic reaction between $H_2^+$ and He is supplied from internal energy in $H_2^+$, then the rate constant should be computed in terms of the fraction vibrationally excited $H_2^+$ with sufficient internal energy to meet the needs of the reaction rather than total $H_2^+$ in the ion source. An estimate of the population of the excited vibrational state in $H_2^+$ produced from $H_2$ by electron impact gives approximately 29% with enough energy to react. The translational energy dependence of the ratio of rate constants reveals a kinetic energy threshold for the $HeH^+$ reaction of about 0.35 ev, but at higher ion kinetic energy there is strong evidence for heat of reaction coming primarily from internal energy in $H_2^+$. An attempt was made to use the $HeH^+$ reaction as a probe to investigate the distribution of excited $H_2^+$ produced from $CH_4$ by electron impact. A third-order process giving $HeH^+$ was discovered in this system. Indications of a larger yield of $H_2^+$ with sufficient energy to react with He were obtained. (auth)

**18046** MEASUREMENTS OF THE VISCOSITY OF KRYPTON. David G. Clifton (Los Alamos Scientific Lab.,

N. Mex.). J. Chem. Phys., 38: 1123-31(Mar. 1, 1963). (LADC-5557)

The viscosity of krypton was measured over the temperature range 297 to 660°K by the oscillating disk method using helium for calibration. The viscosities obtained were used to get the parameters for a Lennard-Jones 12-6 potential function and they were found to be $\epsilon/k = 162$°K and $\sigma = 3.734$ Å. Calculation of the viscosity, thermal conductivity, self-diffusion coefficient, second virial coefficients in the moderate temperature range, and the heat of sublimation at 0°K from the L. J. 12-6 function gives very good agreement with experimental values. Calculated values for the second virial coefficient at low temperatures, the reduced thermal diffusion factor, and the lattice spacing at 0°K are in fair agreement with experiment. (auth)

**18047** STUDY BY ELECTRON PARAMAGNETIC RESONANCE OF IRRADIATED FERROCENE. E. Saito (Centre d'Etudes Nucleaires, Saclay, France). J. Chim. Phys., 59: 1120-1(Nov.-Dec. 1962). (In French)

The irradiation of ferrocene by $Co^{60}$ γ rays was made at 77°K for the powder and 193°K for single crystals. The spectrum of the irradiated powder is very asymmetric and cannot be easily interpreted. The spectrum of the single crystals is very simple for crystals obtained by sublimation. There are two singlets and two doublets. The maximum of the $g_z$ value is found in the direction of the molecule axis. The other two principal g values are in the plane perpendicular to the molecule axis. This spectrum is transformed with time. Single crystals obtained by other methods have spectra with no singlets and the doublets have increased in intensity. In an interpretation of these spectra, the singlet is attributed to a "right" ferricinium ion. A radical with a rotated nucleus can be attributed to the doublet. (J.S.R.)

**18048** AN EXAMINATION OF THE INFRA-RED SPECTRA OF BORATE ANIONS. P. B. Hart and S. E. F. Smallwood (General Electric Co. Ltd., Wembley, Eng.). J. Inorg. Nucl. Chem., 24: 1047-56(Dec. 1962).

A range of metal borate compounds was studied, including a number with unknown structures. The orthoborate ion, $BO_3^{3-}$, was identified in a number of compounds, and some force constants were calculated. The pyroborate ion, $B_2O_5^{4-}$, was found in further compounds, but no assignment of frequencies was made. The spectra of numbers of metaborates and other compounds were also obtained, and in some cases structural conclusions were drawn by comparison with known compounds. It is concluded that in complex compounds inferences about structures and co-ordination must be made with reserve, but that the infrared spectrum of an inorganic borate is a useful means of identification. (auth)

**18049** COMPLEXES OF THE RARE EARTHS. [PART] II. N,N'-ETHYLENEDIAMINE-DIACETIC ACID. L. C. Thompson (Univ. of Minnesota, Duluth). J. Inorg. Nucl. Chem., 24: 1083-7(Dec. 1962).

Step-wise stoichiometric formation constants were determined for the rare earths (including yttrium) with N,N'-ethylenediaminediacetic acid. The measurements were made in aqueous solutions of ionic strength $\mu = 0.1$ ($KNO_3$) and a temperature of 25°C. The data were interpreted in terms of 1:1 and 2:1 chelates. Trends in the values of log $K_1$ and log $K_2$ are discussed and compared with similar values for other aminopolycarboxylate complexes. It is further shown that the values of log $K_2$ are of such a magnitude as to suggest that the rare-earth ions exhibit a co-ordination number larger than six. (auth)

**18050** THE AMMONO-DELIQUESCENCE OF LITHIUM METAL. Meyer M. Markowitz (Foote Mineral Co., Exton, Penna.). J. Inorg. Nucl. Chem., 24: 1475-7(Dec. 1962). (In English)

The physicochemical basis for the absorption of gaseous ammonia by lithium metal is given by vapor pressure-temperature curves for saturated solutions of various alkali metals in liquid ammonia. The lithium-containing solutions show the lowest equilibrium vapor-pressures of ammonia within the temperature ranges covered; thus, at 20°C the vapor pressure of ammonia above a saturated solution of lithium is only 97 mm Hg. Lithium metal easily manifests ammono-deliquescence at room temperature and relatively low pressures of ammonia. (P.C.H.)

**18051** THE SOLUBILITIES OF ALKALI METAL IODIDES IN ETHANOL. J. D. R. Thomas (Welsh Coll. of Advanced Tech., Cardiff, Wales). J. Inorg. Nucl. Chem., 24: 1477-8(Dec. 1962). (In English)

The solubilities of potassium iodide, rubidium iodide, and cesium iodide in ethanol at 20 and 25°C are reported. The data are tabulated. (P.C.H.)

**18052** COMPLEXES OF LANTHANIDE ELEMENTS WITH MERCAPTO ACETATE LIGANDS. J. L. Bear, G. R. Choppin, and J. V. Quagliano (Florida State Univ., Tallahassee). J. Inorg. Nucl. Chem., 24: 1601-6(Dec. 1962).

Stability constants were determined by the Bjerrum method for the complexes of the α-mercaptoacetate ion with yttrium(III) and several trivalent lanthanide ions. The investigation indicates that the α-mercaptoacetate ion acts as a monodentate ligand. (auth)

**18053** KINETICS OF REACTION BETWEEN PLUTONIUM(III) AND CHLORINE IN CHLORIDE SOLUTIONS. A. S. Ghosh Mazumdar, K. P. R. Pisharody, and R. N. Singh (Atomic Energy Establishment, Trombay, India). J. Inorg. Nucl. Chem., 24: 1617-21(Dec. 1962).

Oxidation of plutonium(III) to (IV) by chlorine is shown to follow an apparently first order rate law, with respect to both the reactants, when other conditions are constant. The rate is independent of acidity, but markedly dependent on the chloride ion concentration, and this dependence is shown to be due to a specific effect of chloride ions rather than to a general effect of anions or ionic strength. (auth)

**18054** THE CHEMISTRY OF PROTACTINIUM. VI. THE POLAROGRAPHY OF PROTACTINIUM. C. Ferriera de Miranda and A. G. Maddock (Cambridge Univ., Eng.). J. Inorg. Nucl. Chem., 24: 1623-33(Dec. 1962).

Irreversible polarographic waves are observed in oxalate, citrate, sulphate, and fluoride solutions of protactinium. Fluoride solutions show two waves, at −1.29 and −1.56 v vs S.C.E., for a fluoride concentration of 3.8M. The first wave can be attributed to the reduction of the fluoro complex of Pa(V) to the corresponding complex of Pa(IV). The second wave may be due to the reduction of Pa(IV) → Pa(III). Polarograms in oxalate and sulphate solutions give less meaningful results. (auth)

**18055** OBSERVATIONS ON THE RARE EARTHS. LXXVI. THE STABILITIES OF THE TRANS-1,2-DIAMINOCYCLOHEXANE-N,N'-TETRAACETIC ACID CHELATES OF THE TRI-POSITIVE IONS. T. Moeller and T. M. Hseu (Univ. of Illinois, Urbana). J. Inorg. Nucl. Chem., 24: 1635-43(Dec. 1962).

Interaction between trans-1,2-diaminocyclohexane-N,N' tetra-acetic acid and tripositive rare-earth metal ions was investigated. The formation constants of the hydrogen chelates (LnHZ) and of the normal chelates ($LnZ^-$) were

evaluated at 20, 30, and 40°C and an ionic strength of 0.10 ($KNO_3$), the former by a titration technique and the latter by a mercury indicator-electrode technique. Enthalpy and entropy changes characterizing the formation of the normal chelates were calculated at 25°C. These and functions of the partial molal entropy of the normal chelates were compared with corresponding values for related chelating agents. The significance of a configurational entropy contribution is particularly apparent for the complexes of this somewhat sterically limited ligand. (auth)

**18056** THE ASSOCIATION OF WATER MOLECULES WITH THE EXTRACTED BENZOHYDROXAMIC ACID CHELATES OF URANIUM(VI) AND IRON(III). C. E. Meloan and W. W. Brandt (Purdue Univ., Lafayette, Ind.). J. Inorg. Nucl. Chem., 24: 1645-50(Dec. 1962).

The number of molecules of water associated with the benzohydroxamic acid chelates of uranium(VI) and iron(III) when extracted into alcohols was determined to be $6 \pm 1$ and $9 \pm 3$ respectively. A general relationship was established between the amount of chelate extracted by an alcohol and the amount of water soluble in it. (auth)

**18057** INDEXES OF REFRACTION OF $Mg_2Si$, $Mg_2Ge$, and $Mg_2Sn$. D. McWilliams and D. W. Lynch (Ames Lab., Ames, Iowa). J. Opt. Soc. Am., 53: 298-9(Feb. 1963). (IS-502)

The refractive indexes of $Mg_2Si$, $Mg_2Ge$, and $Mg_2Sn$ were determined by measuring the angle of minimum deviation for monochromatic infrared radiation passing through prisms of these compounds. Results are shown in a graph of indexes vs wavelength. (M.C.G.)

**18058** EFFECTS OF RARE-EARTH-ION SUBSTITUTION UPON THE FLUORESCENT LIFETIME OF TERBIUM IN THE COMPOUND TERBIUM HEXA-ANTIPYRENE TRI-IODIDE. G. E. Peterson and P. M. Bridenbaugh (Bell Telephone Labs. Inc., Murray Hill, N. J.). J. Opt. Soc. Am., 53: 494-5(Apr. 1963).

Additional evidence for the theory that an ion pair resonance mechanism of energy transfer plays an important role in the dissipation of energy within a crystal was derived from a study of the fluorescent lifetime of the $^5D_4$ metastable state of terbium in the compound terbium rare-earth hexa-antipyrene tri-iodide. Erbium, holmium, and neodymium ions caused a notable decrease in the terbium fluorescent lifetime, indicating relatively strong couplings between terbium and erbium, holmium, or neodymium. (D.C.W.)

**18059** DEDUCTIONS FROM SMALL PRIMARY DEUTERIUM ISOTOPE EFFECTS. Edward R. Thornton (Univ. of Pennsylvania, Philadelphia). J. Org. Chem., 27: 1943-4 (June 1962).

Discussion is given on the use of primary deuterium isotope effects of small magnitude in conjunction with calculations to show whether the transition state is product-like or reactant-like. The primary deuterium isotope effect can be of nearly any magnitude, depending on the force constants of the transition state relative to those of the reactant. If the transition state has force constants exactly like those of the reactants, the kinetic isotope effect $k_H/k_D$ is 1.00. If the transition state has force constants exactly like those of the products, $k_H/k_D$ is the same as the equilibrium isotope effect $K_H/K_D$ for the reaction. If the XH and HY force constants of the transition state are equal, $k_H/k_D$ has some max value of 7 or more. It was concluded that the kinetic isotope effect must always be greater than $K_H/K_D$ if the transition state structure is on the product side of symmetrical. Therefore, if $K_H/K_D$ were, say, 1.5 and $k_H/k_D$ were 1.2, the transition state for the reaction must in reality be closer to reactants than to products. If, on the other hand, $K_H/K_D$ were less than 1.00 and $k_H/k_D$ were also much less than 1.00, the transition state must be closer to products than to reactants. The concept was examined by application of the experimental data in 2 cases involving the abstraction of H atoms from toluene and deuterotoluenes by Cl atoms. (P.C.H.)

**18060** STUDIES ON THE SYSTEM $Na(Nb_{1-x}Ta_x)O_3$. Hiroshi Iwasaka and Takuro Ikeda (Nippon Telegraph and Telephone Public Corp., Tokyo). J. Phys. Soc. Japan, 18: 157-63(Feb. 1963).

The phase relations of the system $Na(Nb_{1-x}Ta_x)O_3$ in the solid state are studied by means of the dielectric constant measurements, x-ray diffraction studies, and optical observations. The transition point vs composition curve of this system exhibits a discontinuity in $0.55 > x > 0.54$. The solid solutions with the composition range $x \leq 0.54$ show two transition temperatures, one of which was determined by the dielectric measurements and the other by the optical means. These two transition temperatures increase with increasing value of x showing a maximum near $x = 0.1$, and then decrease monotonically. The room temperature phase is antiferroelectric in this range. In the range $x \geq 0.55$ the dielectric anomaly corresponding to the ferroelectric Curie point exists below room temperature and it decreases monotonically with increasing value of x. Dielectric anomaly, however, is not found in $NaTaO_3$, and it may not be ferroelectric down to liquid helium temperature. Three transitions at higher temperatures are observed only by optical means. (auth)

**18061** TEMPERATURE DEPENDENCE OF THE SPONTANEOUS MAGNETIZATION IN HOLMIUM NITRIDE. Yoshio Ebina (Tohoku Univ., Sendai). J. Phys. Soc. Japan, 18: 189-94(Feb. 1963).

On the assumption that each $Ho^{+3}$ ion has the two lowest lying levels, the temperature dependence of the spontaneous magnetization of HoN is discussed by a spin wave approximation. The approximate spin wave functions considered in the present study are so constructed as to include the basal wave functions for the one ion hamiltonian composed of the terms of the cubic crystalline fields and the effective exchange field parallel to (100). These numerical computations are carried out by using the numerical data of previous papers. Due to the partial quenching of the angular momentum, the averaged z-component of the total angular momentum J over these wave functions is found to be reduced essentially from $J = 8$ in free state. The temperature dependence of the spontaneous magnetization of HoN departs from the usual Bloch $T^{\frac{3}{2}}$ law and is well in accordance with the experimental data. (auth)

**18062** SURVEY OF RESEARCHES ON THE FORMATION AND REDUCTION OF URANIUM HEXAFLUORIDE. Shigeo Tsujimura. Kogyo Kagaku Zasshi, 65: 1146-50 (Aug. 1962). (In Japanese)

**18063** PARAMAGNETIC RESONANCE OF THE TRIPOSITIVE CURIUM ION IN ETHYLSULFATE AND TRICHLORIDE CRYSTALS. Marvin Abraham, B. R. Judd, and H. H. Wickman (Univ. of California, Berkeley). Phys. Rev., 130: 611-12(Apr. 15, 1963). (UCRL-10567)

The paramagnetic resonanee of the ion $Cm^{3+}$ is studied by incorporating various amounts of curium in crystals of lanthanum ethylsulfate and anhydrous lanthanum trichloride. For the ethylsulfate crystals, a single line is observed at helium temperatures, characterized by $g_{\parallel} = 1.925$ and $g_{\perp} = 7.73 \pm 0.02$. A similar line, for which $g_{\parallel} = 1.925 \pm 0.002$ and

$g_\perp = 7.67 \pm 0.02$, occurs for the trichloride crystals. These lines are interpreted as corresponding to transitions within the lowest doublet of the ground level $5f^7\ ^8S_{7/2}$, which, owing to the high degree of intermediate coupling, does not possess the extremely small splitting typical of S states. The Landé g value of the ground level is found to be 1.925. (auth)

**18064** DIVALENT RARE EARTH SPECTRA SELECTION RULES AND SPECTROSCOPY OF $SrCl_2:Sm^{2+}$. J. D. Axe and P. P. Sorokin (International Business Machines Corp., Yorktown Heights, N. Y.). Phys. Rev., 130: 945-52 (May 1, 1963).

Selection rules for vibronic transitions appearing in $4f \rightarrow 4f$ fluorescence of divalent rare earth ($RE^{2+}$) ions in alkaline-earth halide lattices are derived. These are applied to the cases of $SrF_2:Sm^{2+}$, $SrCl_2:Sm^{2+}$, and $CaF_2:Tm^{2+}$. On the basis of a simple theory that outlined, selection rules for nonradiative (relaxation) transitions of $RE^{2+}$ ions in m3m symmetry are also presented. From these rules one can predict instances where spectral broadening of fluorescent lines should occur due to spontaneous emission of phonons, with consequent lifetime broadening. Comparison with experiment seems to verify these predictions. The structure of the $4f^{n-1}$ 5d bands of $RE^{2+}$ ions is shown to be due to vibronic coupling of pure electronic states with states involving multiquantum excitation of even-parity vibrations. Simple coupling schemes for the $4f^{n-1}$ 5d levels are examined. Results of measurements of $SrCl_2:Sm^{3+}$ absorption and fluorescence spectra are presented. Lifetimes and quantum efficiencies are discussed. (auth)

**18065** FERROMAGNETIC RESONANCE OF HOLMIUM NITRIDE. Noboru Tsuya and Yoshio Ebina (Tohoku Univ., Sendai). Phys. Rev., 130: 960-1(May 1, 1963).

Taking into account the quantum mechanical contraction of the spin moment due to the partial quenching of the angular momentum of the trivalent holmium ions, the effective g factor of the ferromagnetic compound HoN is obtained by means of a spin-wave approximation and neglecting the effect of the sixth-order cubic crystalline field. It is also assumed that only the two lowest lying states of each ion need be considered, and that there is no accidental crossover between them. Using a parameter that is estimated from the effective Bohr magneton number observed, the value of the effective g factor is predicted to be about 8. (auth)

**18066** PARAMETRIZED SLATER MODIFIED HARTREE-FOCK METHOD APPLIED TO ACTINIDE IONS. Carl J. Lenander (Univ. of California, Los Angeles). Phys. Rev., 130: 1033-5(May 1, 1963).

A Slater modified Hartree-Fock calculation is applied to several actinide ions. The coefficient of the Slater free electron exchange potential is treated as a parameter that is evaluated by matching a calculated 4f orbital of $Pr^{3+}$ to a Hartree-Fock 4f orbital. The parameter is then used in the calculation of orbitals for $Th^{2+}$, $U^{4+}$, $Np^{4+}$, and the trivalent ions from $Pa^{3+}$ to $Cf^{3+}$. The valence orbitals are used to calculate the matrix elements $\langle r^2\rangle$, $\langle r^4\rangle$, $\langle r^6\rangle$, $\langle r^{-3}\rangle$, $\zeta$, $F^2$, $F^4$, and $F^6$ which are presented in tabular form. (auth)

**18067** THE DEUTERIUM EXCHANGE REACTION BETWEEN p-XYLENE AND DEUTERIUM OXIDE CATALYZED BY SULPHURIC ACID. Tomiko Ueda (Osaka Univ.). Shokubai (Tokyo), 1: No. 1, 1-7(1959). (In Japanese)

The exchange reaction of deuterium between p-xylene and deuterium oxide was studied using sulfuric acid and sodium hydroxide as the catalysts to elucidate the mechanism of the reaction between aromatic compounds and deuterium oxide. The reaction products were analyzed by mass spectrometry and infrared spectroscopy. It was found that in the case of sulfuric acid the hydrogen atoms of benzene ring of p-xylene were exchanged at random with deuterium oxide at 50 to 100°C, while in the case of sodium hydroxide the exchange reaction was not observed even at 150°C. The results were interpreted, assuming that p-xylene forms some molecular complex with sulfuric acid as a reaction intermediate. (auth)

**18068** EXCHANGE OF ACTIVE HYDROGEN FOR DEUTERIUM IN SPECTROSCOPIC STUDIES. H. M. Fales (National Heart Inst., Bethesda, Md.) and A. V. Robertson. Tetrahedron Letters, No. 3, 111-15(Feb. 1962).

The effect of replacement of active H by D on the infrared absorption band of the O-H or N-H stretching mode was studied. A simple technique, which avoids the possibility of back-exchange, is described for study of the effect. A small droplet of $D_2O$ is placed on the top of the solution in the infrared absorption cell (generally 1-cm path carbon tetrachloride solvent). In double-beam techniques a small droplet is also added to the reference cell. Exchange of O-H or N-H in the solute for O-D or N-D then occurs rapidly by diffusion and is essentially quantitative within 15 min and without shaking the cells. Application of the technique is illustrated using Amaryllidaceae alkaloids. Because of its rapidity and simplicity, the process is recommended for use on a routine basis with new compounds, both as a means of identifying signals from active H's and to expose fine structure of bands which overlap such signals. The method fails for hydroxyl groups known to be strongly bonded intramolecularly. (TCO)

**18069** PHYSICAL PROPERTIES OF HEAVY OXYGEN WATER. PART I. DENSITY AND THERMAL EXPANSION. F. Steckel and S. Szapiro (Weizmann Inst. of Science, Rehovoth, Israel). Trans. Faraday Soc., 59: 331-43(Feb. 1963).

The densities of $H_2O^{18}$ and $D_2O^{18}$ were measured and the following values obtained: $H_2O^{18}$, $d_4^{30} = 1.107845 \pm 0.000033$, and $D_2O^{18}$, $d_4^{30} = 1.21393 \pm 0.00008$. The melting points were found by measuring the time-temperature-curve of warming. The following values were obtained: $H_2O^{18}$, $t_{mp} = 0.28 \pm 0.02$°C and $D_2O^{18}$, $t_{mp} = 4.02 \pm 0.02$°C. The thermal expansions were measured in small dilatometers from the melting points to ~80°C. The following values for the maximum densities were obtained: $H_2O^{18}$, $t_{max} = 4.305 \pm 0.02$°C, $d_{max} = 1.11255 \pm 0.00003$ g/ml, and $D_2O^{18}$, $t_{max} = 11.46 \pm 0.03$°C, $d_{max} = 1.21691 \pm 0.00008$ g/ml. An empirical equation covered by all data for the thermal expansion of all water species from the melting points to 80°C, is the following: $1 - d/d_{max} = F\tau^2\,[1.74224 + (482.502/\tau + 77.861)] \times 10^{-6}$, where $\tau = t - t_{max}$, $F = 1$ for $H_2O$ and $H_2O^{18}$, $F = 1.0555$ for $D_2O$ and $D_2O^{18}$. (auth)

**18070** EFFECTS OF WATER VAPOUR ON THE DECOMPOSITION OF MAGNESIUM HYDROXIDE. R. F. Horlock, P. L. Morgan, and P. J. Anderson (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Trans. Faraday Soc., 59: 721-8(Mar. 1963).

Previous work is extended by a study of the decomposition reaction in the presence of controlled water vapor pressures in the range 0.04–4.6 mm. The decomposition kinetics follow the same topochemical pattern as in vacuo but the rate of the interface reaction is reduced by water vapor. The plausibility of attributing this to adsorption of water at the reaction interface is discussed. The time lag between removal of $H_2O$ from the hydroxide lattice and crystallization of MgO (which is very pronounced in vacuo)

becomes progressively less as $p_{H_2O}$ increases, so that with a pressure >0.3 mm it is no longer detectable. This effect is shown to be due to a retardation of $H_2O$ removal from the hydroxide rather than an acceleration of the crystallization of MgO, so that any supposed catalytic role of $H_2O$ vapor in the crystallization of the product phase is not positively substantiated in the $Mg(OH)_2$ decomposition. The effect of $H_2O$ on the nature of the resulting MgO was investigated by $N_2$ sorption; the oxides produced in vacuo have larger crystallite size than those formed in the presence of water vapor, but their pore structures are similar. (auth)

**18071** PHYSICO-CHEMICAL PROPERTIES OF RARE EARTH METALS, SCANDIUM AND YTTRIUM. E. M. Savitskii, V. F. Terekhova, and O. P. Naumkin. Usp. Fiz. Nauk, 79: 263-93(Feb. 1963). (In Russian)

Atomic and crystal structure and physical and chemical constants of 98 to 99% pure rare earths were studied. Electric magnetic, optical, mechanical, and nuclear properties of rare earths are surveyed at low and high temperatures and at ordinary and high pressures. Constitution and phase diagrams are analyzed, and reactions between the rare earth metals and reactions with other elements are discussed. The special properties and applications of rare earths as superconductors, semiconductors, ferromagnetics, cathode materials, neutron absorbers, catalyst, and luminophors are evaluated. 116 references are included. (R.V.J.)

**18072** HYDROGEN–DEUTERIUM EXCHANGE IN THE MONOMOLECULAR CHEMISORPTION LAYER ON PLATINUM FILMS VAPOR DEPOSITED IN ULTRAHIGH VACUUM. Horst Gentsch (Technische Hochschule, Hanover). Z. Physik. Chem. (Frankfurt), 35: 69-85(Nov. 1962). (In German)

The kinetics of the reaction $H_{2(ads)} + D_2 \rightleftharpoons D_{2(ads)} + H_2$ was investigated on thin Pt films (80 Å) between 77 and 295°K. Simultaneously the variation of the electrical resistance of the film was followed. The measurements were limited to the monomolecular chemisorption layer. An Omegatron mass spectrometer in a reduced pressure circuit was used for the gas analysis in the pressure range from $10^{-10}$ to $10^{-3}$ torr. The difference of the chemisorption heats of $H_2$ and $D_2$ were calculated from the isotope effects; it is 230 cal/mole at a coating of $2.8 \times 10^{15}$ molecules/cm$^2$ ($\Theta = 0.92$). At temperatures >173°K, the exchange is immeasureably fast; at 77 and 90°K a reduction of the reaction velocity was observed. The resistance variation in the chemisorption of $H_2$ and $D_2$ on Pt films are equal in contrast to Pd films. (tr-auth)

**18073** THE EQUIVALENT CONDUCTANCE OF ELECTROLYTES IN MIXED SOLVENTS. IX. URANIUM(IV) CHLORIDE IN THE WATER-ETHANOL SYSTEM. Don Roach and Edward S. Amis (Univ. of Arkansas, Fayetteville). Z. Physik. Chem. (Frankfurt), 35: 274-88(Dec. 1962). (In English)

The equivalent conductance of $UCl_4$ in water-ethanol systems wad determined. The $UCl_4$ undergoes hydrolysis readily in water and water-rich solvents. Solutions of $UCl_4$ in pure ethanol were found to be stable as long as they were kept free of oxygen. The solutions in mixed solvents were found to be unstable. Conductance data are presented in graph form. (M.C.G.)

**18074** STRUCTURE AND MAGNETIC PROPERTIES OF TRANSITION METAL HYDRIDES. Bohdan Stalinski. Zeszyty Nauk. Politech. Wroclaw., Chem., No. 17, 25-78 (1957).

The systems La–H, Ti–H, Zr–H, and Ta–H were the object of x-ray-diffraction and magnetochemical investigations. It was established that all of the systems, excepting Zr–H which has two, form one hydride phase. In nearly all the systems, the dissolution of H leads to a linear expansion of the crystal lattice of the metal. Only in the hydride phase of La does the lattice constant drop in proportion to the H concentration growth. The unit cell structure either remains the same, or (Zr–H, Ta–H) is deformed. On an increase of the H concentration the susceptibility of the metals drops (Zr, Nb, Ta) or grows (Ti). The sign of the temperature coefficient of the Nb and Ta susceptibility changes from negative to positive under the action of H. An increase of interatomic distances in the Ti hydride causes a significant rise of the temperature dependence of susceptibility and also the appearance, on the curve of this dependence, of a maximum characteristic of antiferromagnetic materials. Significant variations in susceptibility and its temperature coefficient in the systems under investigation indicate that the H atoms pass over to the ionic state during the process of dissolution. (OTS)

**18075** A METHOD FOR CALCULATING THE DIAMAGNETIC SUSCEPTIBILITY OF HELIUM. P. Sh. Fridberg and V. K. Shugurov. Zh. Eksperim. i Teor. Fiz., 43: 2308 (Dec. 1962). (In Russian)

Damburg and Iolin calculated the diamagnetic susceptibility for the ground state of helium, $\overline{r^2} = 1.935$ (in atomic mass units), with functions of the Khilerassa type by varying some 80 parameters. Without attempting to contradict the results of this calculation, the wide divergence between the calculated value and the experimental data ($\overline{r^2} = 1.220 \pm 0.006$) is pointed out, indicating that the calculated value appears to be poorly asymptotic. The high precision of the calculated value is evidence of the good quality of the function only at average distances whereas such calculations should also be valid at great distances. The $\overline{r^2}$ values were calculated by the comprehensive function of Foka for 1-, 2-, and 3-configured approximations with only 5 parameters and show that better agreement with experimental data is obtained. The range of these values was from 1.208 to 1.233 with an average of 2.19. An estimate of the contributions of the configuration $3s^2$, $3p^2$, $3d^2$ reveals that an agreement even better than 0.005 can be obtained. It was concluded that the comprehensive Foka method is better adapted to both short and average distances where it can be confirmed by calculations of the energy and hyperfine structure, and that this method can also be used to better advantage for greater distances. (TTT)

**18076** THE MECHANISM OF PARAMAGNETIC SPIN-LATTICE RELAXATION IN IONIC CRYSTALS AT LOW TEMPERATURES. S. A. Al'tshuler (Kazan State Univ., USSR). Zh. Eksperim. i Teor. Fiz., 43: 2318-19(Dec. 1962). (In Russian)

Recently, in order to remove the difficulties that were encountered in the theory of Kronig and Van Kleck, it was speculated that the most effective mechanism of spin-lattice relaxation responsible for the exchange-coupled pairs is the existence of strong spin-phonon bonds which were revealed experimentally. It was assumed that the relaxation through exchange-coupled pairs easily explains two experimental facts, obviously contradicting the theory of Kronig-Van Kleck: strong dependence of the relaxation time, $T_1$, with the paramagnetic fractions and the slight dependence of $T_1$ with the applied magnetic field. These facts also led to simple explanations of the occasionally observed anomalous dependence of $T_1$ with T. It is postulated

that relaxation through exchange pairs is effective only in crystals with so high a concentration of paramagnetic ions, that broad resonance lines are being compared with the least interval, through the separation of the resonance peaks of individual particles from those peaks which belong to pairs. In lesser concentrations the spin-spin interactions cannot provide the transmission energy necessary to go from individual particles to pairs, because their energy spectra are completely different. In ruby crystals the existence of two different mechanisms of spin-lattice relaxation was previously experimentally established leading to different degrees of temperature dependence of $T_1$. Anomalies of temperature dependence were observed in crystals with concentrations of paramagnetic ions, exceeding 0.2%. Calculations revealed that for crystals with average concentrations of paramagnetic ions, the greatest effect can be shown by applying certain parametric limitations to the relaxation formula. Detailed calculations were carried out for a ruby crystal. The following parametric values were used, $J(\bar{r}) \approx 10^{-3}$ cm$^{-1}$ ($\bar{r}$ = 27 Å as the average distance between particles). When $\bar{r} \sim 6$ Å, then $J \sim 0.5$ cm$^{-1}$, the value of the exchange interval appears to be permissible, even more so since it does not contradict the data concerning the breadth of the resonance lines. If the crystals oriented perpendicularly to the magnetic field are assigned the spin levels of $Cr^{3+}$ for the transitions 2-4, 1-2, 2-3, 3-4, the relaxation times, at T = 20°K, as calculated in this work are 10 : 6 : 8.6 : 7.2 milliseconds and compare favorably with the measured values 10 : 6 : 8 : 4 reported by Pace et al. (TTT)

**18077** EFFECT OF SHAPE OF MOLECULE ON THE RATE OF MAGNETIC RELAXATION IN LIQUIDS. [PART] II. K. A. Valiev, R. Kh. Timerov, and R. M. Yulmeev (Kazan Pedagogical Inst. and Inst. of Physics and Tech., Kazan Branch, Academy of Sciences, USSR). Zh. Eksperim. i Teor. Fiz., 44: 522-9(Feb. 1963). (In Russian)

The magnetic resonance line widths and longitudinal relaxation times are calculated for nonspherical liquid particles. Brownian rotation of the particles is characterized by the diffusion tensor $D_{ij}$. The calculations are performed for quadrupole and dipole interactions between nuclear spins and also for anisotropic g-factors and hyperfine and Stark interaction constants in the case of electron spins. (auth)

**18078** ORTHOBARIC DENSITIES AND CRITICAL PARAMETERS OF ZIRCONIUM(IV) AND HAFNIUM(IV) HALIDES. L. A. Nisel'son and T. D. Sokolova (State Research and Design Inst. of Rare-Metal Industry, Moscow). Zh. Neorgan. Khim., 7: 2653-60(Dec. 1962). (In Russian)

Orthobaric densities of hafnium and zirconium tetrachlorides, bromides, and iodides in the liquid phase were determined, and critical parameters for these compounds were calculated. (R.V.J.)

**18079** STUDIES OF GASEOUS $ZrCl_4$, $HfCl_4$, $NbCl_5$, AND $TaCl_5$ REACTIONS WITH KCl BY MEANS OF RADIOACTIVE TRACERS. I. Zvara and L. K. Tarasov (Joint Inst. for Nuclear Research, Dubna, USSR). Zh. Neorgan. Khim., 7: 2665-70(Dec. 1962). (In Russian)

Thermodynamic data are developed for $K_2ZrCl_6$, $K_2HfCl_6$, $KNbCl_6$, and $KCl-NbOCl_3$. Vapor reactions of $ZrCl_4$, $HfCl_4$, $NbCl_5$, $TaCl_5$, and $NbOCl_3$ with KCl were investigated over a wide range of pressures. (R.V.J.)

**18080** ON COMPLEX AMINOCATIONS OF RARE EARTH ELEMENTS. R. A. Chupakhina and V. V. Serebrennikov. Zh. Neorgan. Khim., 7: 2699-701(Dec. 1962). (In Russian)

The preparation of rare earth complexes with nicotinic acid and hexathiocyanotochromium, (Ln $Nicot_3$) $[Cr(CNS)_6]$, where Ln is La, Ce, Pr, Nd, Sm, Gd, Tb, Ho, Er, Lu, and Y, is described and their solubility in water determined at 25°C. The variability of molecular electric conductance indicates the instability of the compounds in aqueous solutions. (R.V.J.)

**18081** SYNTHESIS AND SOME PROPERTIES OF POTASSIUM DIZIRCONATE. A. A. Grizik, V. E. Plyushchev, and I. A. Pleskova. Zh. Neorgan. Khim., 7: 2702-8(Dec. 1962). (In Russian)

Chemical and x-ray phase analyses were made of potassium zirconate compounds: $K_2O \cdot 2ZrO_2$ and $K_2O \cdot 3ZrO_2$. The properties of the $K_2O \cdot 2ZrO_2$ system (hydrolysis, thermal stability, and reactions with various reagents) were determined. (R.V.J.)

**18082** COMPLEX COMPOUNDS OF LANTHANUM AND YTTERBIUM WITH MALIC ACID. N. K. Davidenko. Zh. Neorgan. Khim., 7: 2709-15(Dec. 1962). (In Russian)

Complex compounds of La and Yb with malic acid were studied and it was found that Ln $Mal^+$ (where Ln = La or Yb) forms in acid solutions and LnOH Mal or Ln Mal in near neutral solutions. The stability constants of La and Yb (Ln $Mal^+$ type) malic acid complexes are calculated. At an ionic strength of $\mu = 0.12$ and at 21 to 22°C, they are $K_{La\ Mal^+} = 2.4 \times 10^4$ and $K_{Yb\ Mal^+} = 8.3 \times 10^4$. (R.V.J.)

**18083** INDIUM CITRATE COMPLEXES. D. I. Ryabchikov, I. N. Marov, and K'o-min Yao. Zh. Neorgan. Khim., 7: 2716-24(Dec. 1962). (In Russian)

Potentiometric and high-frequency titration and ion exchange methods were used in studies of indium complexing with citric acid. In acid and neutral media, In and citric acid form 1 : 1 ratio complexes. The composition of indium citrate formed in neutral media with a charge 1 is $InC_6H_4O_7$. Indium citrate complexes $Na[In(C_6H_4O_7) \cdot (H_2O)_2]$ and $H[In(C_6H_4O_7) \cdot (H_2O)_2]$ were synthesized. (R.V.J.)

**18084** ON COMPLEX COMPOUNDS OF MULTIVALENT METALS WITH TRIOXYFLUORONES. V. A. Nazarenko, N. V. Lebedeva, E. A. Biryuk, and M. B. Shustova. Zh. Neorgan. Khim., 7: 2731-8(Dec. 1962). (In Russian)

Spectrophotometric studies of phenylfluorone reactions with Ge, Zr, and Sb and propylfluorone with Sc indicated that the metal ion replaces one hydrogen atom in the molecule. It also showed that trioxyfluorone reacts with multivalent metals as do orthohydroxyquinones but not like orthodiphenols. The optimum conditions are found for the reaction of zirconium with phenylfluorone, and it is shown that zirconium and phenylfluorone form a 1 : 2 complex. (R.V.J.)

**18085** REACTION OF TIN CHLORIDES WITH RARE EARTH, IRON, AND SODIUM CHLORIDES. Ch'ih-Fa Li and I. S. Morozov. Zh. Neorgan. Khim., 7: 2765-70(Dec. 1962). (In Russian)

The combined crystallization of Ce, La, Fe, and Sn chlorides in melts was studied and phase diagrams were constructed for the systems: $CeCl_3-SnCl_2$, $CeCl_3-FeCl_2$, $LaCl_3-SnCl_2$, $FeCl_2-LaCl_3$, $FeCl_2-SnCl_2$, and $NaCl_2-SnCl_2$ (eutectic type diagrams). The liquidus surface was found for the systems: $CeCl_3-NaCl-SnCl_2$, $CeCl_3-FeCl_2-SnCl_2$, and $FeCl_2-LaCl_3-SnCl_2$ and phase diagrams were developed. Tensiometric studies of binary chloride systems indicated the feasibility of separating Sn chlorides from rare earth chlorides. (R.V.J.)

**18086** DETERMINATION OF VAPOR PRESSURE IN SOLID ANHYDROUS YTTRIUM AND SAMARIUM CHLO-

RIDES. A. S. Pashinkin, D. V. Drobot, E. N. Shevtsova, and B. G. Korshunov (Inst. of Fine Chemical Tech., Moscow and Moscow State Univ.). Zh. Neorgan. Khim., 7: 2811-13(Dec. 1962). (In Russian)

The vapor pressure was determined for saturated yttrium trichloride at 498 to 625°C and for samarium chloride at 501 to 582°C. The data on the vapor pressure as a function of temperature and the heat of sublimation, calculated by the least squares method, are tabulated. (R.V.J.)

**18087** X-RAY DIFFRACTION INVESTIGATION OF SCANDIUM, YTTRIUM, CERIUM, NEODYMIUM AND GADOLINIUM ORTHOVANADATES. V. A. Naumov. Zh. Strukt. Khim., 3: 608-11(1962).

Research was carried out to obtain more accurate values of the cell parameters of Sc, Y, Ce, Nd, and Gd orthovanadates. The specimens were obtained by sintering $V_2O_5$ with the metal oxides (in the case of Ce, heating to 850°C was used instead of sintering). No lines attributable to the reactants could be detected. The tabulated results provide the following information: hkl, I, d (in kX), $1/d^2$ (both measured and calculated). The obtained data coincide within ±0.01 to 0.03 Å with previous data. (P.C.H.)

**18088** ELECTRON MICROSCOPY AND STRENGTH OF CRYSTALS. Proceedings of the First Berkeley International Materials Conference "The Impact of Transmission Electron Microscopy on Theories of the Strength of Crystals" held at the University of California, Berkeley, July 5-8, 1961. Gareth Thomas and Jack Washburn, eds. New York, Interscience Publishers, 1963. 1031p.

Proceedings of the First Berkeley International Materials Conference "The Impact of Transmission Electron Microscopy on Theories of the Strength of Crystals" held at the University of California, Berkeley, July 5 to 8, 1961, are presented. The 24 papers are grouped under two headings: single-phase materials and phase transformations. Separate abstracts were prepared for 3 papers. (M.C.G.)

**18089** DEFECTS IN QUENCHED AND IRRADIATED FACE-CENTERED CUBIC METALS. M. J. Whelan. p.3-40 of "Electron Microscopy and Strength of Crystals." New York, Interscience Publishers, 1963.

The electron microscope evidence obtained so far on the microstructure of quenched and irradiated face-centered cubic metals is reviewed and discussed in the light of evidence obtained from measurement of other physical properties. Topics covered include: defects produced by quenching; defects in quenched Al, Au, Cu, Ni, Ag, and alloys; dark spot defects produced by quenching; annealing experiments; observations of defects produced by irradiation; and nature of defects. (M.C.G.)

**18090** ON THE ORIGIN OF DISLOCATION TANGLES AND LONG PRISMATIC DISLOCATION LOOPS IN DEFORMED CRYSTALS. D. Kuhlmann-Wilsdorf and H. G. F. Wilsdorf. p.575-604 of "Electron Microscopy and Strength of Crystals." New York, Interscience Publishers, 1963.

A series of investigations was conducted on tangles of dislocations in crystals. The geometry of dislocation tangles, circumstances under which tangles are formed, mechanisms that could cause tangling, reasons why cross slip and intersection jogs cannot be the primary cause for tangling, interactions between point defects and dislocations as cause of tangling, absorbed point defects in dislocation cores, the mechanism of point defect production during slip, and the role of thermal activation in dislocation tangling and the formation of long prismatic loops are discussed. (M.C.G.)

**18091** THE STRUCTURE OF PRECIPITATION-HARDENED ALLOYS. G. Thomas. p.793-859 of "Electron Microscopy and Strength of Crystals." New York, Interscience Publishers, 1963.

The applications of thin-foil techniques to the investigation of alloy structures are discussed. The aging sequences for precipitation hardening is described. The effects of cold work on precipitation are outlined. Reasons for discontinuous precipitation are listed. The interactions of dislocations and precipitates are discussed. Intergranular fracture and stress-corrosion cracking are described. Results of direct observations of precipitation are presented. (M.C.G.)

## Organic Chemistry

*Refer also to abstract 18501.*

**18092** (BNL-6278) MOLECULAR GEOMETRY AND THE VAPOR PRESSURES OF THE ISOTOPIC ETHYLENES: CHEMICAL AND STRUCTURAL ISOMERS. Jacob Bigeleisen, Slobodan V. Ribnikar, Marvin J. Stern, and W. Alexander Van Hook (Brookhaven National Lab., Upton, N. Y.). [nd]. Contract AT(30-2)-Gen-16. 20p.

The theory of isotope effects on vapor pressures for systems with large quantum effects, as manifested by the cross-over phenomenon and deviation from the rule of the mean, is illustrated by the large body of experimental data on the isotopic ethylenes which has recently become available. An effect of molecular geometry was found, viz. a difference in vapor pressures of cis-, trans-, and gem-dideuteroethylenes. This was shown to be related to the hindered rotation about the C=C axis in the liquid. A further consequence of the hindered rotation was established, namely a perturbation of the out of plane molecular vibrations. This is a new effect for which a one to one correspondence with the molecular symmetry was established. Quantitative calculations show that this rotation-vibration coupling further enhances the effect of the hindered rotation. A theoretical calculation of the vapor pressure differences of the isotopic ethylenes from molecular data is made through statistical mechanical theory and the calculation of the energy states of the isotopic ethylenes. The agreement with the experimental data, which encompasses a significant number of different parameters, is quantitative. (auth)

**18093** THE STRUCTURE OF STRYCHNOSPERMINE. EVIDENCE FROM DOUBLE IRRADIATION AND VARIABLE TEMPERATURE N.M.R. F. A. L. Anet (Univ. of Ottawa). Can. J. Chem., 41: 883-8(Apr. 1963).

The nuclear magnetic resonance spectrum of strychnospermine was measured at −20°, room temperature, and at +80°. The changes observed are attributed to restricted rotation in the N-acetyl group. At room temperature the rate of rotation is such that the band of one aromatic proton is extremely broad and therefore almost invisible. Double irradiation was used to determine the environment of the C-methyl group of the alkaloid. The nuclear magnetic resonance results confirmed the structure previously postulated. (auth)

**18094** ZIRCONIUM IN ORGANIC CHEMISTRY. Warren B. Blumenthal (National Lead Co., Niagara Falls, N. Y.). Ind. Eng. Chem., 55: 50-7(Apr. 1963).

A broad sketch of the behavior of the zirconium atom toward organic molecules and radicals is given. The chemistry of zirconium and its place in organic chemistry is considered. The characteristics of the zirconium atom that are most significant to its role in organic chemistry are: its atomic radius, its tetravalence, its ability to form

compounds in which it manifests coordination numbers 4, 5, 6, 7, and 8, and its tendency to attain the highest coordination number that is sterically possible. The extent to which zirconium will react with various molecules, a wide diversity of compounds with different ligands bound to the same zirconium atom, and the great tendency of zirconium compounds to form solvates and other complexes and to polymerize are provided. Thirty-two references are cited. (C.E.S.)

**18095** PREPARATION OF TRITIATED PHENOLS. II. SYNTHESIS OF THYROID HORMONES LABELED WITH $H^3$ (DL-THYROXINE AND IODO-3,5,3′-DL-THYRONINE). J. Nunez, Cl. Jacquemin, and J. Roche (Collège de France, Paris). Intern. J. Appl. Radiation Isotopes, 13: 611-16 (Nov.-Dec. 1962). (In French)

Tritium labeled DL-thyroxine and 3,5,3′-triodo-DL-thyronine were synthesized using labeled hydriodic acid in a general tritiation method. Both were labeled in the $\alpha$-$\beta$ positions of the side chain. $I^{131}$-labeling of tritiated 3,5 diiodothyronine gave rise to double-labeled thyroxine and 3,5,3′ tri-iodothyronine. The purity of the synthetic compounds was controlled, and good agreement was obtained between the experimental and the theoretical specific activities of the synthesized compounds. The position and stability of the incorporated tritium atoms were established. (P.C.H.)

**18096** RADIOLABELED INSECTICIDES: SYNTHESIS OF N-METHYLCARBAMATES VIA METHYL ISOCYANATE-$C^{14}$ AND CHROMATOGRAPHIC PURIFICATION. Jataprolu G. Krishna, H. Wyman Dorough, and John E. Casida (Univ. of Wisconsin, Madison). J. Agr. Food Chem., 10: 462-6(Nov.-Dec. 1962).

A simple and efficient procedure for $C^{14}$-labeling of N-methylcarbamate insecticides is reported. The chromogenic reagents for the phenols and chromatographic systems used in developing the procedure are also given. Synthesis of the following compounds is described: Sevine (1-naphthyl-N-methylcarbamate); the N-methylcarbamate of m-isopropylphenol (Hercules 5727); o-isopropoxyphenol (Bayer 39007); 4-methylthio-3,5-xylenol (Bayer 37344); and 4-dimethylamino-3,5-xylenol (Zectran). Labeling of the methyl or carbonyl group appears desirable, based on the fact that: the synthetic procedure might be applicable for radiolabeling a variety of N-methylcarbamates; the N-methylcarbamoyl group is the toxophoric group based on structure-activity studies and the finding that cholinesterase may be carbamoylated by this type of compound; N-methylcarbamates may hydrolyze to yield methyl isocyanate as an intermediate before formation of methylamine and $CO_2$; and the problem of cleanup for $C^{14}$-counting is greatly facilitated with these labeling sites as methylamine-$C^{14}$ and $C^{14}O_2$ can be readily released and trapped for counting. The syntheses were carried out by reacting acetyl-$C^{14}$ chloride and sodium azide to yield methyl-isocyanate-$C^{14}$, which was then reacted with the appropriate phenol. A 2-compartment reaction tube with a break-seal was utilized. Yields on a 0.5-mmole scale were routinely 40 to 70%. Chromatographic procedures for isolating the N-methylcarbamates from their reaction mixtures are also reported. (H.H.D.)

**18097** PHOTOCHEMICAL DIMERIZATION OF 2-AMINOPYRIDINES AND 2-PYRIDONES. Edward C. Taylor and Robert O. Kan (Princeton Univ., N. J.). J. Am. Chem. Soc., 85: 776-84(Mar. 20, 1963).

Ultraviolet irradiation of 2-aminopyridine, 2-amino-5-chloropyridine, 2-amino-3-methyl-, 4-methyl-, 5-methyl-, and 6-methylpyridines, and of N,6-dimethyl-2-iminopyridine in hydrochloric acid solution resulted in the formation of 1,4-dimers. A similar series of photodimers was prepared from the corresponding 2-pyridones, and the two series were directly interrelated by alkaline hydrolysis of the tetrahydro dimer of 2-aminopyridine to the tetrahydro dimer of 2-pyridone. Assignment of the anti-trans configuration to all dimers was made on the basis of a detailed study of their n.m.r. spectra. The unusual chemical and physical properties of these dimers are discussed. (auth)

**18098** ISOTOPE EFFECTS IN RECOIL TRITIUM REACTIONS WITH HYDROCARBONS. John W. Root and F. S. Rowland (Univ. of Kansas, Lawrence). J. Am. Chem. Soc., 85: 1021-2(Apr. 5, 1963).

The abstraction reaction of recoil tritium was investigated on $CH_2D_2$ and on competitive mixtures of protonated and deuterated methanes and n-butanes. For $CH_2D_2$, the isotope effect for hydrogen abstraction is ~1.32 for HT/DT between 1 and 5% $O_2$. For the competitive mixtures, the isotope effect is 1.31 for $CH_4$ and $CD_4$ vs $C_4H_{10}$, and 1.21 for $C_4H_{10}$ and $C_4D_{10}$ vs $CH_4$. It is suggested that the isotope effects are primarily probability integral isotope effects. (D.L.C.)

**18099** DEUTERIUM ISOTOPE EFFECTS IN RATES OF METHYLENE RADICAL INSERTION INTO CARBON–HYDROGEN BONDS AND ACROSS CARBON DOUBLE BONDS. J. W. Simons and B. S. Rabinovitch (Univ. of Washington, Seattle). J. Am. Chem. Soc., 85: 1023-4 (Apr. 5, 1963).

The relative rates of methylene addition across the double bond and of methylene insertion into the allylic and vinylic C-H bonds were studied at 25 and –30°. The experiments were conducted by photolyzing ketone in the presence of cis-butene-2 and cis-butene-2-$d_8$. The rate constant ratios and isotope effects are tabulated. (D.L.C.)

**18100** ERRATUM: STATISTICAL MECHANICS OF IRREVERSIBLE PROCESSES IN POLYMER SOLUTIONS. Jerome J. Erpenbeck (Los Alamos Scientific Lab., N. Mex.) and John G. Kirkwood. J. Chem. Phys., 38: 1023-4(Feb. 15, 1963). (LADC-5542)

In the paper "Statistical Mechanics of Irreversible Processes in Polymer Solutions" there was an error in the theory resulting from the use of Eq. 11 for Brownian motion outside of chain space. This error is corrected, and the perturbation term in the diffusion equation is now made up of the original Kirkwood term plus a term in the velocity field outside chain space. (M.C.G.)

**18101** SOME APPLICATIONS OF NUCLEAR MAGNETIC RESONANCE SPECTROSCOPY TO ORGANIC CHEMISTRY. A. R. Katritzky (Cambridge Univ., Eng.). Record Chem. Progr. (Kresge-Hooker Sci. Lib., 23: 223-41(Dec. 1962).

Some of the uses of nuclear magnetic resonance spectroscopy in organic chemistry are illustrated. Topics covered include: phosphorus chemistry, prototropic tautomerism, pyridone cation structure, rapid molecular rearrangements, and conformational analysis. (M.C.G.)

## Radiation Chemistry and Radiochemistry

*Refer also to abstracts 17642 and 18476.*

**18102** (BNL-6257) THE THERMAL DECOMPOSITION OF $NaBrO_3$. PART II. IRRADIATED MATERIAL. Joseph

Jach (Brookhaven National Lab., Upton, N. Y.). [1961]. Contract AT(30-1)-Gen-16. 27p.

Studies of the thermal decomposition of $NaBrO_3$ were extended to include material pre-irradiated with $Co^{60}$ and reactor irradiations. The primary effect of the irradiation appears to be an enhancement of the melting rate of the eutectic formed between $NaBrO_3$ and the product NaBr, and is accompanied by an enhanced decomposition rate. The conclusion reached with unirradiated material that alternate decomposition routes exist such as at dislocations and other defects is strengthened. (auth)

**18103** (BNL-6849) COPOLYMERIZATION OF ETHYLENE INDUCED BY COBALT-60 GAMMA RADIATION. Peter Colombo and Meyer Steinberg (Brookhaven National Lab., Upton, N. Y.). [Mar. 1963]. Contract [AT (30-2)-Gen-16]. 43p.

The gamma-initiated copolymerization of ethylene with a number of different monomers was studied at 20°C and initial pressures to 680 atmospheres. The experiments were conducted statically in two-phase systems with the exception of the ethylene-carbon monoxide system. Isolation of the copolymers was effected by solvent extraction and fractional precipitation techniques. Infrared spectroscopy was used for identification. The composition was determined by elemental analysis. A partial evaluation of some of the reaction products including crystalline melting points, densities, solubility characteristics, and molecular weights are given. Evidence of ethylene copolymerization was established with each of the following monomers: styrene, methyl methacrylate, vinyl acetate, acrylonitrile, allyl acetate, isobutylene, chlorotrifluoroethylene, trans 2-butene, methyl acrylate, isoprene, propylene, vinyl chloride, 1-butene, cis 2-butene, Co vinyl pyrrolidone, methyl vinyl ketone, and divinyl benzene. The experimental data obtained in the study of the ethylene-carbon monoxide system were found to obey a linear form of the copolymer composition equation. The ratio of specific rate constants for carbon monoxide and ethylene ($\alpha$) was found to have a value of 22.0, indicating that carbon monoxide is a monomer, is activated to the extent that it adds 22 times as fast as an ethylene monomer to an ethylene free radical chain end. (auth)

**18104** (CEA-Bib-25) MICROCALORIMÉTRIE APPLIQUÉE A L'ÉTUDE DES RAYONNEMENTS. (Microcalorimetry Applied to Radiation Studies. A Bibliography). M. LePape (France. Commissariat à l'Energie Atomique. Centre d'Etudes Nucléaires, Saclay). 1963. 31p.

Ninety-three abstracts on microcalorimetry applied to radiation studies are presented, covering the period 1946 to 1962. An author index is included. (M.C.G.)

**18105** (JAERI-1040) RADIOLYSIS OF BIPHENYL. Akibumi Danno, Genichi Tsuchihashi, and Hiroaki Koyama (Japan Atomic Energy Research Inst., Tokyo). 1963. 34p. In Japanese.

Biphenyl was irradiated with gamma rays, and the G-values of the polyphenyls produced by the irradiation were determined. The reverse isotope dilution technique was applied to determine the G-values of the products, by using $G^{14}$-labeled biphenyl and the liquid elution chromatography. Based on the G-values of all isomers of terphenyl and quaterphenyl, the mechanism of radiolysis of biphenyl was investigated. (auth)

**18106** (NYO-10145) RESEARCH APPLICATIONS OF KRYPTON-85. Quarterly Progress Report, October 1 – December 31, 1962. Authur M. Feibush (Air Reduction Co. Inc. Central Research Labs., Murray Hill, N. J.). Contract AT(30-1)-2906. 11p.

Investigation of the polymerization of acetylene at high pressure, induced by $\beta$-radiation from $Kr^{85}$ was continued. Some physical and chemical properties of the polymer were studied. It was concluded that the polymer does not react rapidly with air but the possibility of a slow reaction is suggested. Microscopic examination showed the material to be in the form of porous clumps with glassy surfaces. Examination of the polymer with the electron microscope showed that it was in the form of sheets but did not reveal any regular structure. The feasibility of forming polymer films on metal and glass surfaces using $Kr^{85}$ radiation to cause polymerization was demonstrated. Further investigation of this technique is planned. (auth)

**18107** (RRL-87) METHYL RADICAL PRODUCTION IN THE RADIOLYSIS OF HYDROCARBONS. Robert H. Schuler and Robert R. Kuntz (Mellon Inst. Radiation Research Labs., Pittsburgh). Aug. 27, 1962. Contract AT (30-1)-2310. 33p. (NYO-10308)

Radioiodine scavenging methods were employed in the radiolysis of liquid hydrocarbons to examine details of the production and reaction of methyl radicals. Carrier-free chromatographic separation of the radio-methyl iodide enabled studies to be carried out at iodine concentrations down to $5 \times 10^{-7}$ M. In the radiolysis of 2,2,4-trimethylpentaneiodine solutions at room temperature the methyl iodide yield is shown to be independent of iodine concentration above $10^{-5}$ M. Competition between the scavenging reaction and abstraction of hydrogen from the solvent by the methyl radicals was observed in the region of $10^{-6}$ M. In the absence of iodine the methane yield is shown to be dependent on absorbed dose rate in the region of $10^7$ rads/hr. At this dose rate the abstraction process competes effectively with the reaction between methyl radicals and other alkyl radicals. Measurement of the competition rates of the above reactions, together with rate information from paramagnetic resonance experiments, allows an estimate of $3 \times 10^8$ liters $mole^{-1}$ $sec^{-1}$ to be made for the absolute second-order rate constant for the reaction of methyl radicals with molecular iodine in liquid 2,2,4-trimethylpentane. The efficiency of reaction per encounter is shown to be close to unity with little or no activation energy involved. A survey of methyl radical production from various hydrocarbons showed that carbon-methyl bond rupture deviates substantially from that predicted by a simple model involving only a statistical consideration of the number of methyl groups in the molecule. The yields were found to be very markedly dependent on specific details of the structure of the species being irradiated. For individual homologous series the methyl radical yields were observed to be decreasing monotonic functions of the chain length of the hydrocarbon. For the paraffins and isoparaffins the yield was proportional to the inverse square of the number of carbon-carbon bonds in the molecule. By a generalization of this relationship, an empirical rule was developed which allows reasonable quantitative estimates to be made for the methyl radical yields from even highly branched hydrocarbons. (auth)

**18108** (TID-18126) RADIATION-INDUCED REACTIONS IN SWOLLEN POLYMERS. Annual Report. Morton A. Golub and Robert L. Walrath (Stanford Research Inst., Menlo Park, Calif.). Nov. 30, 1962. Contract AT(04-3)-115. 19p.

The radioinduced grafting of acrylonitrile onto polyethylene oxide in both in situ and postirradiation cases was investigated. It was found that $\gamma$-irradiation of polyethylene oxide (POLYOX) swollen with acrylonitrile both in the

presence and in the absence of benzene resulted in insoluble products which could not be fractionated. Based on infrared analysis, solubility characteristics, and the observed difficulty of inducing postirradiation grafting of acrylonitrile onto Polyox, it was concluded that the irradiated swollen polymer consisted of a completely entangled network of crosslinked polyacrylonitrile and polyethylene oxide chains with a very minor amount, at most, of grafted polymer. Moreover, the dry resin is crosslinked when irradiated in vacuum or in an inert atmosphere such as nitrogen, and is somewhat degraded when irradiated in air. In either case, trapped free radicals are formed in sufficient concentration ($4.52 \times 10^{17}$/g as measured by electron spin resonance) to make postirradiation grafting possible. However, the maximum amount of such grafting obtained in the polyethylene oxide-acrylonitrile system was only about 1% and 3% of monomer by weight when the polymer was treated in the form of crumb and as thin films, respectively, with ethylene glycol as solvent. A somewhat higher degree of grafting (about 3% acrylonitrile grafted onto Polyox crumb) was obtained with a 50:50 dimethyl sulfoxide-water mixture as solvent, but even here the extent of reaction was too slight to merit any practical interest in grafting acrylonitrile onto polyethylene oxide. Other monomers employed in postirradiation grafting runs onto Polyox were styrene, vinyl acetate, methyl methacrylate, methyl acrylate, butyl acrylate, acrylic acid, acrylamide, butadiene, and isoprene. Corresponding in situ experiments with most of these polymer monomer combinations produced generally parallel results. Substantial grafting was obtained with acrylamide, less with methyl acrylate and butyl acrylate, and little or none with the remaining monomers. These results support the generalization that polyethylene oxide is a difficult substrate on which to graft vinyl monomers. Nevertheless, in the case of acrylamide, grafts were obtained containing 22.5% and 45% grafted monomer by weight for postirradiation and in situ grafting, respectively. The nuclear magnetic resonance spectra of the latter products showed proton resonance bands which were too broad to permit any determination of microstructure although they supported the estimates of degree of grafting based on nitrogen analysis. From the standpoint of physical properties, postirradiation grafting onto polyethylene oxide produced a relatively insoluble resin which can swell in almost all solvents. However, the initial solubility characteristics of the Polyox resin are such as to make it impracticable to swell it to various controlled extents with different monomers for in situ irradiation. In any event, the latter frequently results in a highly insoluble product which is difficult or impossible to characterize. (auth)

**18109** (TID-18305) CHEMICAL DOSIMETRY AT HIGH DOSE RATES. Edwin J. Hart (Argonne National Lab., Ill.). Jan. 1963. Contract [W-31-109-eng-38]. 22p. (UAC-7229)

The effects of change from steady-state radiation to pulsed radiation on dosimetry and on the type and magnitude of chemical changes brought about in irradiated materials are discussed. Sections are included on chemical dosimetry, chemistry of irradiated water, pulsed electron beam dosimetry, the ferrous sulfate dosimeter, and the water dosimeter. (J.R.D.)

**18110** (UCRL-6967) THE FORMATION OF PROTONS FROM WATER BY ELECTRON IMPACT. F. S. Baker and G. O. Brink (California. Univ., Livermore. Lawrence Radiation Lab.). July 26, 1962. Contract W-7405-eng-48. 7p.

The relative cross section for the production of protons from water by electron bombardment was measured by a modulated crossed beam technique over an energy range from threshold to 500 ev. The appearance potential for protons was measured by comparison with the ionization potential of hydrogen and found to be 19.4 ev. This result is in agreement with earlier results. The overall curve is smooth with the exception of a slight shoulder at about 45 ev. This shoulder may indicate the presence of more than one process for the formation of protons. (auth)

**18111** (AEC-tr-5707) CONTINUOUS MEASUREMENT OF THE CONCENTRATION OF SOLUTIONS BY MEANS OF BREMSSTRAHLUNG FROM LOW ENERGY, BETA EMITTERS. W. Kuhn. Translated for Los Alamos Scientific Lab., N. Mex. from Chem.-Ingr.-Tech., 32: 747-9(1960). 9p.

A method for measuring the concentration of solutions utilizing tritium absorbed on zirconium as a $\beta$-ray source is described. The resulting $\gamma$ radiation is used for continuous absorption measurement of the solutions. A continuous display of the data is provided. This measuring process depends more on the atomic number of the irradiated element than on the surface density. The transmitted radiation intensity decreases exponentially with increasing concentration and for equal concentrations, absorption increases with increasing atomic number of the elements in solution which results from the extremely rapid increase of the photoelectric absorption coefficient with atomic number. This method employs very low radiation energy and can be used without radiation protection for personnel. (H.G.G.)

**18112** RADIATION CHEMISTRY OF CARBOHYDRATES. Glyn O. Phillips (University Coll., Cardiff, Wales). Advan. Carbohydrate Chem., 16: 13-58(1961).

A review. (H.H.D.)

**18113** RECOIL REACTIONS IN THE IRRADIATED AQUOPENTAMMINECOBALT(III) COMPLEXES. Nobufusa Saito, Takeshi Tominaga, and Hirotoshi Sano (Tokyo Univ.), Bull. Chem. Soc. Japan, 36: 230-1(Feb. 1963).

Six $[Co(NH_3)_5H_2O]^{3+}$ complexes were irradiated for 1 hour in a thermal neutron flux of $3 \times 10^{11}$ n/cm$^2$/sec and then stored at low temperatures for 1 to 5 days. Then, the irradiated complexes were dissolved in water and the percentages of $Co^{60}$-labeled species determined. The results indicate that the distribution of recoil species is influenced by the kind of outer anions in the target. A plot of the retention of $[Co(NH_3)_5H_2O]^{3+}$ versus the frequency of the maximum in the first absorption band of $Co(NH_3)_5X$ (X = outer anion in target) shows that the retention decreases with the frequency and is similar to that for the corresponding hexamminecobalt(III) complexes. (D.L.C.)

**18114** EFFECTS OF OUTER ANIONS ON THE RECOIL REACTIONS IN THE IRRADIATED NITROPENTAMMINECOBALT(III) COMPLEXES. Nobufusa Saito, Takeshi Tominaga, and Hirotoshi Sano (Tokyo Univ.). Bull. Chem. Soc. Japan, 36: 232-3(Feb. 1963).

Seven $[Co(NH_3)_5NO_2]^{3+}$ complex salts were irradiated and the $Co^{60}$-labeled species separated from the aqueous solutions of the irradiated salts. Plots of the percentage of $Co^{60}$ activity versus the frequency of the maximum in the first absorption band of $Co(NH_3)_5X$ (X = outer anion of target) were made for the retention as $[Co(NH_3)_5NO_2]^{3+}$ and the formation of $[Co(NH_3)_5X]^{2+}$. The percentage of formation increases with frequency, while the percentage of retention is almost unchanged or slightly decreases. (D.L.C.)

**18115** INFLUENCE OF A PULSED ELECTRIC FIELD ON LUMINESCENCE IN THE RARE GASES EXCITED BY

IONIZING RADIATION. Aleksander Szymanski and Jan. A. Herman (Laval Univ., Quebec). Can. J. Chem., 41: 1020-3 (Apr. 1963).

Measurements were made of the variation in intensity of light emission from gases excited by ionizing radiation at the beginning and end of a pulsed electric field. The rare gases helium, neon, argon, krypton, and xenon were studied. They were excited by a beam of x rays. In the case of helium, neon, and argon, no variation in light intensity characteristic of recombination was observed, other than that already described in the literature and due to increased excitation by electrons accelerated by the pulsed field. However, the heavier rare gases behaved differently. At the beginning of the field pulse a very weak decrease in luminescence occurred, which was almost completely masked by the increase produced by the increased excitation caused by accelerated electrons. On the other hand, at the end of the field pulse there was a large increase in luminescence. This showed that in the case of krypton and xenon dissociative recombination plays an active role in the mechanism of luminescence. (M.C.G.)

**18116** TRITIUM DISTRIBUTION IN 4-OCTENE PREPARED BY CATALYTIC HYDROGENATION. S. Borčić, T. Strelkov, and D. E. Sunko (Ruder Bošković Inst., Zagreb). Croat. Chem. Acta, 34: 243-4(1962). (In English)

4-octene was prepared from n-propyl bromide and disodium acetylide in liquid ammonia. The 4-octene was then reduced without solvent in the presence of Lindlar catalyst with tritium gas. Gas chromatography showed the distilled product was pure 4-octene. A determination of the specificity of the tritium label in the 4-octene was then made by ozonizing it in methylene chloride. The ozonide was treated with alkaline hydrogen peroxide, and sodium butyrate was isolated. Measurement of the specific activity showed that 8.82% of the radioactivity in 4-octene is not connected with the hydrogens of the double bond. It was concluded that catalytic hydrogenation is not suitable for specific labeling with hydrogen isotopes. (auth)

**18117** RADIATION CHEMISTRY OF HYDROCARBONS. 5. TEMPERATURE EFFECTS IN TOLUENE. Juerg Hoigné and Tino Gaeumann (Technische Hochschule, Zurich). Helv. Chim. Acta, 46: 365-74(1963). (In German)

The radiation chemistry of liquid toluene was studied between −80 and +180°C and from 1 to 100 Mrad. The yields of the isomeric bitolyls, phenyltoluenes, benzylmethyl-cyclohexadienes, and xylenes and of bibenzyl were measured. The production of the bitolyls increases with temperature, but the ratio of the six isomers remains constant. The percentage of the o,o′ isomer is much lower than expected. The benzyltoluenes do not show any temperature dependence between −80° and +80°, and their isomer distribution is nearly statistical. Part of the results may be discussed within the framework of free radical reactions. (auth)

**18118** THE MECHANISM OF THE RADIATION CHEMICAL DEGRADATION OF AMINO ACIDS. II. DEGRADATION OF α-AMINOBUTYRIC ACID IN AQUEOUS SOLUTION AND NITROGEN ATMOSPHERE AND COMPARISON WITH THE DEGRADATION IN OXYGEN ATMOSPHERE. J. Kopoldová, J. Liebster, and A. Babický (Biological Inst., Czechoslovak Academy of Sciences, Prague). Intern. J. Appl. Radiation Isotopes, 13: 617-22(Nov.-Dec. 1962). (In English)

The degradation of α-aminobutyric acid was studied in aqueous solution in nitrogen atmosphere for the elucidation of the reaction mechanism. Comparison of the products arising in oxygen and nitrogen atmosphere and their yields made it possible to determine the effect of oxygen on the formation of the degradation products. (P.C.H.)

**18119** FORMATION OF HYDRAZINE FROM THE RADIOLYSIS OF AMMONIA IN THE PRESENCE OF MINERAL SOLIDS. H. Kramer, J. Pruzansky, and M. Steinberg (Brookhaven National Lab., Upton, N. Y.). Intern. J. Appl. Radiation Isotopes, 13: 641-5(Nov.-Dec. 1962). (BNL-6016; BNL-5982). (In English)

The formation of hydrazine from the $Co^{60}$ gamma radiolysis of ammonia in the presence of mineral solids was investigated. Sorbed ammonia on Linde Molecular Sieve 13X powder, binder-free (sodium-alumino-silicate structure), indicated a maximum G-value for hydrazine formation of 0.99 based on energy absorbed in ammonia alone. This is 12.4 times the value obtained by radiolysis of anhydrous liquid ammonia. The rate of hydrazine formation with sorbed ammonia in the molecular sieve was found to be 3.3 times that in liquid ammonia. The data appear to indicate a surface effect, which prevents the recombination processes. (auth)

**18120** E.S.R. STUDY OF FREE RADICALS IN IRRADIATED GLYCINE. Ruth F. Weiner and W. S. Koski (Johns Hopkins Univ., Baltimore). J. Am. Chem. Soc., 85: 873-83(Apr. 5, 1963).

The e.s.r. spectra of the free radicals formed by irradiating glycine with x rays were studied. Five compounds were studied with systematic isotopic variation. These were glycine ($NH_3^+-CH_2-COO^-$), $D_2$-glycine ($NH_3^+-CD_2-COO^-$), $N^{15}$-glycine ($N^{15}H_3^+-CH_2-COO^-$), $D_3$-glycine ($ND_3^+-CH_2-COO^-$) and $D_5$-glycine ($ND_3^+-CD_2-COO^-$). Only those radicals which are relatively stable at room temperature were studied. The spectra are interpreted by the possible radical structures $NH_4$ and $CH_2-COO^-$. (auth)

**18121** RADIATION-INDUCED ADDITION OF HYDROGEN SULFIDE TO SUBSTITUTED ACETYLENES. SYNTHESIS OF VINYLTHIOLS. F. W. Stacey and J. F. Harris, Jr. (E. I. du Pont de Nemours and Co., Wilmington, Del.). J. Am. Chem. Soc., 85: 963-5(Apr. 5, 1963).

Vinylthiols were synthesized by the x-ray-initiated addition of hydrogen sulfide to mono- and disubstituted acetylenes at room temperature. Divinyl sulfides, vicinal dithiols, and low polymers of the vinylthiols are also obtained as reaction products. The vinylthiols are colorless, distillate liquids. Their stability varies with the acetylene. The most stable ones are derived from hexafluoro-2-butyne and 3,3,3-trifluoropropyne. In no case was there any evidence for the presence of the tautomeric "thione" in the reaction products. (auth)

**18122** A RADIATION-INDUCED PREPARATION OF TROPYLIUM BROMIDE. Donald H. Martin and Ffrancon Williams (Univ. of Tennessee, Knoxville). J. Am. Chem. Soc., 85: 1014-16(Apr. 5, 1963). (TID-17799)

The production of tropylium bromide by the radiolysis of t-butyl bromide–cycloheptatriene mixtures is reported. The G-value for the formation of tropylium bromide is greatest at high ratios of t-butyl bromide to cycloheptatriene, and yields up to 25 mole % were obtained. Formation of isobutane and isobutene was also detected. The results are consistent with the ionic mechanism $t\text{-}C_4H_9Br^+ \cdot \rightarrow t\text{-}C_4H_9^+ + Br\cdot$, $t\text{-}C_4H_9^+ + C_7H_8 \rightarrow iso\text{-}C_4H_{10} + C_7H_7^+$. (D.L.C.)

**18123** EFFECT OF ATMOSPHERE ON RADIATION-INDUCED CROSSLINKING OF POLYETHYLENE. PART I. DEPRESSIVE EFFECT AND ACCELERATING EFFECT. Yoichi Okada (Sumitomo Bakelite Co., Ltd., Tokyo). J. Appl. Polymer Sci., 7: 695-701(Mar. 1963).

Polyethylene films were irradiated in various atmospheres by gamma rays from a $Co^{60}$ source, and solubility measurements in xylene were carried out at 80°C. In $NO_2$ and $O_2$, the crosslinking of polyethelene was depressed markedly but not so much in $NH_3$, $Cl_2$, and $SO_2$. On the other hand, $N_2O$ accelerated the crosslinking appreciably. In CO and $H_2$, neither the depressive nor the accelerating effect was observed with the limit of error. In $O_2$, the depressive effect was greater at higher gas pressure and at lower dose rate; however, in $N_2O$ the accelerating effect was reduced at higher gas pressure, and showed a dose rate independence within the range of the experiments. (auth)

**18124** EFFECT OF ATMOSPHERE ON RADIATION-INDUCED CROSSLINKING OF POLYETHYLENE. PART II. DEPENDENCY ON DOSE RATE, TEMPERATURE, AND GAS PRESSURE. Yoichi Okada (Sumitomo Bakelite Co., Ltd., Tokyo). J. Appl. Polymer Sci., 7: 703-8(Mar. 1963).

The gel content of polyethylene irradiated in a nitrous oxide atmosphere was higher than when irradiated in vacuum. This was due to an accelerating effect of the nitrous oxide on the radioinduced crosslinking. The dependence of the accelerating effect on the dose rate, temperature during irradiation, and gas pressure is shown. The accelerating effect was independent of the dose rate. While various complicated factors were concerned, the effect appeared to be also nearly independent of temperature. The gel content rapidly increased with gas pressure, passed through a maximum, and than fell. Moreover, the position of the maximum shifted to a region of higher pressure for thicker films. According to the results it may be considered that the accelerating effect is due to radiolytic intermediates of nitrous oxide, which dissolve in polyethylene, and may be a rather fast reaction compared to the depressive effect of oxygen. (auth)

**18125** THE EFFECT OF IONIZING RADIATIONS ON CATALYTIC ACTIVITY. HYDROGENATION AND ISOTOPIC EXCHANGE ON INORGANIC SOLIDS. Harold W. Kohn and Ellison H. Taylor (Oak Ridge National Lab., Tenn.). J. Catalysis, 2: 32-9(Feb. 1963).

Irradiation at −78°C with doses of $Co^{60}$ gamma rays in the range $10^{18}$ to $10^{20}$ ev/g increased, from three to several hundred times, the catalytic activity for hydrogen-deuterium exchange of ZnO, $ThO_2$, $BaTiO_3$, MgO, $V_2O_3$, $KAlSi_3O_8$, and $CaSiO_3$. The catalytic activity of $TiO_2$ (rutile) was virtually unaffected by gamma rays at this temperature but could be increased by exposure to neutrons. The activity of several hydrides (LiH, NaH, $BaH_2$, $CaH_2$) was decreased by irradiation in vacuo, but it was increased (for the two investigated, LiH and $BaH_2$) by irradiation in 20 to 30 mm of $H_2$. The hydrogen-deuterium exchange activity of promoted zinc oxides was virtually unchanged by irradiation, in contrast to the increase with pure ZnO. Activity for ethylene hydrogenation, however, was decreased for both promoted and unpromoted zinc oxides. (auth)

**18126** STABILITY OF THE IODINE–CARBON BOND OF RADIOACTIVE IODOALBUMIN IN THE 50-KV ELECTRON BEAM. Arnold M. Seligman, Jacob S. Hanker, Arlene R. Seaman, and Hannah E. Silberstein (Sinai Hospital, Baltimore). J. Cell Biol., 15: 395(Nov. 1962).

Development of electron-opaque reagents, by labeling aromatic compounds with heavy atoms, was investigated preliminary to histochemical studies using the electron microscope. Reagents containing 3 iodine atoms were surprisingly ineffective in increasing the electron opacity in histochemical methods for functional groups of macromolecules. Besides failure to raise significantly the total density of the macromolecules, a possible explanation could be the loss of iodine from tissue sections under the influence of the 50-kv electron beam on the carbon-iodine bond in a very high vacuum. To test this hypothesis, the loss of radioactivity on exposing radioactive iodoalbumin in a methacrylate section in the electron microscope was determined over a total exposure of 20 min. $I^{131}$–albumin (462 μC/mg) was precipitated from solution with 10 volumes of acetone and suspended in butyl methacrylate containing 10% methyl methacrylate. The methacrylate was polymerized, using 2,2′-azo-bis(2-methylpropionitrile) as a catalyst. The specimen was scanned with the electron beam at full intensity for various time intervals and the radioactivity measured after each exposure to the electron beam. At time intervals of scanning of 2, 5, and 10 min, no significant loss of radioactivity was noted. This demonstrates that iodinated aromatic phenols and amines can tolerate a 50-kv electron beam without loss of iodine for the time needed for ordinary electron microscopic observation. Therefore, histochemical reagents containing many more than 3 atoms of iodine will be required to significantly enhance the opacity of cellular protein constituents with methods that demonstrate functional groups of macromolecules. (H.H.D.)

**18127** CONTRIBUTION TO THE STUDY OF THE RADIOCHEMICAL BEHAVIOR OF SOME SATURATED HYDROCARBONS. I. GENERALITIES AND EXPERIMENTAL METHODS. Jacques Dauphin (Laboratoire de Chimie Physique, Paris). J. Chim. Phys., 59: 1196-1206 (Nov.-Dec. 1962). (In French)

A series of results obtained on the radiolysis of cyclanes and alkanes are reported. The present ideas on the radiolysis mechanism of hydrocarbons are first reviewed. After a short bibliographic summary of the methods used in this type of study, the interception of radioiodine is discussed in some detail. The experimental techniques used, with emphasis on the separation by semimicrodistillation of radioactive iodides resulting from the interception of radicals, are described. A rotating-element column of a new type was perfected for this separation. (tr-auth)

**18128** CONTRIBUTION TO THE STUDY OF THE RADIOCHEMICAL BEHAVIOR OF SOME SATURATED HYDROCARBONS. II. THE CYCLANES. Jacques Dauphin (Laboratoire de Chimie Physique, Paris). J. Chim. Phys., 59: 1207-22(Nov.-Dec. 1962). (In French)

The results obtained in the study of the radiolysis of cyclopentane were reported. At 20°C iodocyclopentane is, by far, the major product of the radiolysis of cyclopentane in the presence of iodine. Non-negligible yields of methyl iodide, 1-iodopentane, and 1,5-diiodopentane were also observed. Hydriodic acid formed by interception of hydrogen atoms can be captured, during radiolysis, by calcium carbonate. The existence of parasitic addition reaction of HI on the alkenes produced by radiolysis is thus shown. The study of the iodide yields in the radiolysis of liquid cyclopentane in the presence of iodine at −78 and +81°C and of cyclopentane vapor at 81°C adds complementary information which allows a rational scheme to be deduced. This scheme is established from experimental results and from general data; its value is limited by the lack of information on the "molecular" products of radiolysis. The interpretation gives a large place to reactions of the parent ion before its neutralization: degradation and ion-molecule reactions. Some results obtained on cyclohexane allow the conclusions obtained by the study of cyclopentane to be generalized to the cyclane series. (tr-auth)

**18129** CONTRIBUTION TO THE STUDY OF THE RADIOCHEMICAL BEHAVIOR OF SOME SATURATED HYDROCARBONS. III. THE ALKANES. Jaques Dauphin (Laboratoire de Chimie Physique, Paris). J. Chim. Phys., 59: 1223-32(Nov.-Dec. 1962). (In French)

Results obtained in the study of the radiolysis of liquid n-pentane in the presence of iodine are reported. The experimental results are very slight and their interpretation is based on the general characteristics of the radiolysis of hydrocarbons. An analogy between the radiochemical behavior of alkanes and of cyclanes is also assumed. The addition reactions of hydriodic acid on the radiolysis alkenes were determined for n-pentane. The results compare well with those for the radiolysis of n-pentane in the absence of iodine, obtained by previous workers. They are exactly between the values of radiochemical yields relative to liquid n-butane and n-hexane in the presence of iodine. This last comparison is very instructive since with it one can define some general aspects of the radiolysis of alkanes in the presence of iodine. The parent iodides are the major products and the yields of secondary iodides are higher than those of the primary iodide. The degradation of the carbon chain does not occur by a simple coupling mechanism. A report of some results obtained on isopentane is also given. (tr-auth)

**18130** RADIOLYSIS OF SILICON TETRACHLORIDE IN THE PRESENCE OF VINYL MONOMERS. Nicole Gislon-Leray (Laboratoire de Chimie Physique, Orsay, France). J. Chim. Phys., 59: 1255-8(Nov.-Dec. 1962). (In French)

The study of the radiolysis of mixtures of silicon tetrachloride and styrene shows a sensitization by silicon tetrachloride. The determination of the radiochemical yields $G_n$ was made by two methods: the displacement between the two series of results permits evaluation of the transfer constants of the $C_s$ chain. In the case of mixtures of methyl methacrylate and of silicon tetrachloride, the polymerization is disturbed in the region corresponding to high concentrations of silicon tetrachloride by the precipitation of the polymer. (tr-auth)

**18131** NEUTRON-INDUCED REACTIONS IN IODOBENZENE. J. E. C. Macrae and P. F. D. Shaw (Clarendon Lab., Oxford). J. Inorg. Nucl. Chem., 24: 1327-36(Dec. 1962). (In English)

The organic yields of radioiodine produced by neutron irradiation of mixtures containing iodobenzene and iodine were investigated; they were unaffected by a slow radiolytic exchange reaction and there was little evidence that they are influenced by thermal exchange occurring in the zone. The results can be explained by assuming that in such systems, phenyl radicals react to form iodonium radicals by addition to iodobenzene molecules. In the presence of benzene, organic yields are reduced, possibly by reaction between phenyl radicals and benzene to form diphenyl compounds. This explanation is consistent with the absence of any self-scavenging effect in solutions of iodine in benzene. (auth)

**18132** EFFECTS OF NEUTRON CAPTURE UPON BENZENE SOLUTIONS OF ORGANIC IODIDES. J. E. C. Macrae and P. F. D. Shaw (Clarendon Lab., Oxford). J. Inorg. Nucl. Chem., 24: 1337-50(Dec. 1962). (In English)

An attempt was made to distinguish between thermal and hot yields of radioiodine in mixtures of benzene and organic iodides. Mechanisms to explain the general pattern of yields are discussed; the simplest one involves competitive reactions of phenyl radicals with benzene or the iodides present. (auth)

**18133** HOT-ATOM CHEMISTRY OF COBALT COMPLEXES. I. HOT-ATOM CHEMISTRY OF NITROAMMINE COBALT(III) COMPLEXES. N. Saito, T. Tominaga, and H. Sano (Tokyo Univ.). J. Inorg. Nucl. Chem., 24: 1539-48 (Dec. 1962).

Nine kinds of nitroamminecobalt(III) complex compounds were irradiated with slow neutrons for 1.5 or 30 hours in JRR-1 reactor. After various storage times the $Co^{60}$-labeled recoil species in the irradiated compounds were separated by means of procedures involving paper electrophoresis, paper chromatography, ion exchange, or precipitation. It was found that the labeled species were composed of the target complex, $Co^{2+}$ ion and the complexes produced through incorporation of outer ions (or molecules) as ligands. The results can be explained by assuming that an electrostatic interaction plays an important role in recoil reactions. The effects of irradiation and storage time on the distribution of recoil species were also investigated. (auth)

**18134** A METHOD OF TRITIUM LABELING. M. W. Lindauer and H. A. Smith (Univ. of Tennessee, Knoxville). J. Org. Chem., 27: 2245-6(June 1962).

A method of tritium labeling, which depends upon the rapid exchange of tritium with carboxyl hydrogen atoms in the presence of a noble metal catalyst such as rhodium, is reported. The specific activities of the product obtained are dependent on the fraction of T in the H gas employed in the exchange reaction. The method was applied to the synthesis of tritiated acetic acid and tritiated N-methylpyrrole. The activity of acetic acid obtained by decomposition of labeled malonic acid was 36 mC/mole while that of N-methylpyrrole obtained by decarboxylation of N-methylpyrrole-2-carboxylic acid was 8 mC/mole. The efficiency of the exchange-decarboxylation method is $\sim 10^5$ times that found when the Wilzbach method is applied to the labeling of toluene. While the method of labeling described is not so general as that of Wilzbach, it should be applicable to any compound containing a carboxyl group that can be decarboxylated readily. It has the advantage of employing low activities of T and short exposure times and producing products of high purity labeled in specific positions. (TCO)

**18135** THE RADIATION-INDUCED ADDITION REACTION OF ALCOHOLS TO PERHALOGENO OLEFINS. Hiroshige Muramatsu (Government Industrial Research Inst., Nagoya, Japan). J. Org. Chem., 27: 2325-8(July 1962).

A study was made of the $\gamma$ radioinduced addition reaction of alcohols to perhalogeno olefins, such as 1,2,2-trichloro-1-fluoroethylene, 1,2-dichloro-1,2-difluoroethylene, and 1,1-dichloro-2,2-difluoroethylene. The general reaction is: $CHR_1R_2OH + CFX = CX_2 \rightarrow CHX_2CFXCR_1R_2OH$, where X = F or Cl; $R_1$ = H or $CH_3$; $R_2$ = H, $CH_3$, or $C_2H_5$. In preliminary experiments, benzoyl peroxide was found to be effective for the addition reaction, but benzoates of alcohols were produced as byproducts whose boiling products were similar to the 1:1 adducts. The $\gamma$ radioinduced addition reaction of 1,2,2-trichloro-1-fluoroethylene and 1,2-dichloro-1,2-difluoroethylene gave mainly 1:1 adducts in appreciable yields. 1,1-Dichloro-2,2-difluoroethylene reacted with alcohols under the influence of $\gamma$ radiation to form telomers. The yields and physical properties of the 1:1 adducts, the new halogeno alcohols, are tabulated. The trend in gross reactivity observed in the addition of alcohols to 1,2-dichloro-1,2-difluoroethylene is as follows: $(CH_3)_2CHOH > CH_3(CH_2)_2OH$, $CH_3CH_2OH > CH_3OH$. Chemical reactions were used to determine the direction of the addi-

tions of α-hydroxyalkyl radicals formed to 1,2,2-trichloro-1-fluoroethylene and 1,1-dichloro-2,2-difluoroethylene. The results confirm the general rule for the addition of radicals to the olefins, that is, that the radicals add to the side having less steric hindrance. (TCO)

**18136** RADIOCHEMICAL PURITY OF TRITIUM EXCHANGE LABELED BARBITAL. C. R. Boshart, G. K. W. Yim, and T. S. Miya (American Cyanamid Co., Pearl River, N. Y.). J. Pharm. Sci., 51: 385-6(Apr. 1962).

Barbital (diethylmalonylurea) was isotopically labeled with tritium by the Wilzbach gas exposure procedure. The specific activity of the tritiated barbital was 266 mC/g after removal of labile tritium. The following criteria of homogeneity were employed: recrystallization to constant specific activity using 2 solvent systems; column liquid-liquid partition and paper chromatography; and evidence for stability after injection in rabbits. It was concluded that a product with a high degrée of radiochemical purity and stability suitable for pharmacologic studies was obtained. After removal of labile tritium by exchange with water, the barbital-t retained ~96% of the remaining isotope through recrystallization and chromatography. This is the highest yield yet reported for the Wilzbach exchange-labeling method. Its final specific activity was 253 mC/g. This represents the presence of ~1 tritium atom per 610 molecules of barbital. The results are unusual since there was little evidence for the presence in the labeled material initially of a high specific activity contaminant. (H.H.D.)

**18137** A STUDY OF FREE RADICAL FORMATION ON IRRADIATION OF POLYISOBUTENE USING A RADIOACTIVE DISULFIDE SCAVENGER. G. Ayrey (Queen Elizabeth Coll., London) and D. T. Turner. J. Polymer Sci., Pt. B, 1: 185-8(Apr. 1963).

An extension was made of quantitative scavenging techniques to a purified and thoroughly degassed polyisobutene having a viscosity of $10^9$ poise ($\overline{M}_v \sim 10^6$) at 20°C. A doubly labeled scavenger, phenyl-$H^3$-sec-butyl-$S^{35}$-disulfide, was chosen for this study because it satisfied the restrictive requirements of solubility in the polymer and an unequivocal scavenging role. It was found that the compound scavenges a polymer radical with cleavage of the disulfide bond mainly by elimination of the resonance stabilized benzenesulphenyl radical. Mixtures of the polymer with varying portions of disulfide were exposed simultaneously with water cooling to a beam of 4-Mev electrons. Comparison with results for mobile hydrocarbons indicated that a high viscosity does not reduce the yield of radicals but increases the concentration of scavenger needed to trap them by about one order of magnitude. (M.C.G.)

**18138** RADIATION INDUCED GRAFT COPOLYMERIZATION OF STYRENE ON TO NYLON 6. Ichiro Sakurada, Toshio Okada, and Sadao Torikai (Japanese Association for Radiation Research on Polymers, Osaka). Kobunshi Kagaku, 18: 550-6(1961). (In Japanese)

The effects of irradiation atmosphere, dose rate, solvent, and solvent/monomer ratio on the grafting of styrene to nylon 6 film were studied. It was found that the induction period of the grafting in the presence of air was very short. The amount of grafted polystyrene after an integrated dose of $1.0 \times 10^5$ roentgens was inversely proportional to the square root of the intensity between 50 and 2000 roentogen/min. The effect of the solvent on the grafting was very remarkable. Organic solvents studied in this experiment were methanol, ethanol, n-butanol, sec-butanol, tert-butanol, isobutanol, benzene, acetone, carbon tetrachloride, dimethylformamide and m-cresol. The addition of 1% water or 3% methanol to the grafting mixtures noticeably accelerated the rate of grafting. The lower the carbon chain length of aliphatic alcohol, the more effective was the acceleration of the grafting. In styrene-alcohol mixtures three maxima of the amount of grafting were observed for monomer/solvent ratio. In the mixture of styrene and organic solvent except methanol, a slight or no increase of acceleration was observed. Some experiments on the grafting of styrene in the presence of divinylbenzene were also carried out. (auth)

**18139** PROPERTIES AND STRUCTURE OF POLYVINYL ALCOHOL FILM GRAFTED WITH STYRENE BY γ-RAY IRRADIATION. Waichiro Tsuji, Ryozo Kitamaru, and Terumichi Ichiba (Kyoto Univ.). Kobunshi Kagaku, 19: 389-96(1962). (In Japanese)

Polyvinyl alcohol film pretreated with water was irradiated in styrene with $Co^{60}$ γ-ray. Then the graft polymerization of styrene to polyvinyl alcohol film proceeded with the irradiation. The grafted film expanded almost eveniy to the three dimensional directions. Styrene grafted polyvinyl alcohol film was cut into small pieces. Using those test pieces, specific gravity, degree of swelling in water and benzene, heat plasticity, etc., were measured. It was found that there was little difference in the properties of the inner layer and the surface layer of the film. This fact indicates that graft copolymerization would proceed homogenously in the outer and inner parts of films except extremely thick ones. (auth)

**18140** RADIATION-INDUCED IONIC REACTIONS: CYCLOPENTADIENE POLYMERIZATION. T. H. Bates (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Nature, 197: 1101-2(Mar. 16, 1963).

Investigations on the radiation-induced polymerization of certain monomers provided evidence for the production of ionic as opposed to radical initiation. Pure cyclopentadiene was irradiated with $Co^{60}$ γ radiation. At −78.5°C a gel was formed after conversion of 1.6% of the monomer to polymer. The results of carbon-hydrogen analysis fitted an empirical formula $C_5H_6$. The efficiency of the reaction at low temperature, and the necessity for rigorous drying to attain high yield are criteria for the non-participation of radical processes. A mechanism for radiation-induced polymerization was formulated. (C.E.S.)

**18141** STORAGE OF STANDARDIZED RADIOACTIVE SOLUTIONS. J. H. Harley, N. A. Halliden, and I. M. Fisenne (U. S. Atomic Energy Commission, New York). Nature, 197: 1230(Mar. 23, 1963).

A series of tests was performed to determine if appreciable losses occur through adsorption on the walls in the normal use of polyethylene bottles for the storage of radioactive solutions. The radioisotopes tested include $Cs^{137}$, $Ce^{144}$, $Zr^{95}$, $I^{131}$, $Ru^{106}$, and $Ba^{140}$. Results show that all the nuclides may be kept in solution by the addition of appropriate acid or carrier, except in the case of Ru. Ruthenium adsorbs appreciably on polyethylene and even at best 25% remains on the bottle wall. (C.H.)

**18142** OPTICAL AND ELECTRIC PHENOMENA IN LiF CRYSTALS WITH COBALT. K. Huml and A. Bohun (Inst for Solid Physics, Chechoslovak Academy of Sciences, Prague). Phys. Status Solidi, 3: 250-3(1963). (In German)

Measurements are made of the absorption, thermo-stimulated exoelectron emission, and luminescense, of non-irradiated and x-irradiated LiF crystals with Co impurities. It is considered that the results indicate the formation of Co complexes and clusters. (auth)

**18143** THE ELECTRET EFFECT IN PARAFFIN WAX. J. Gomulkiewicz (University Coll., Wroclaw, Poland). Phys. Status Solidi, 3: 276-82(1963). (In English)

Electrets were prepared from pure paraffin wax by irradiation with $\beta$ rays followed by formation in a constant electric field. The charge of the electrets was measured by means of the inductive method and with Faraday cylinder. The dependence of the electret charge on intensity of forming field, forming time, irradiation time, and storage time after irradiation, and the permanence of the charge, were investigated. Electrets prepared in this way had charges of the same order of magnitude as thermic electrets made from carnauba wax and formed in similar forming fields. (auth)

**18144** A STUDY OF MÖSSBAUER ABSORPTION IN IRON SILICATES. M. de Coster, H. Pollak, and S. Amelinckx (Centre d'Étude de l'Énergie Nucléaires, Mol, Belg.). Phys. Status Solidi, 3: 283-8(1963). (In English)

The Mössbauer resonance absorption was measured in various silicates containing iron. The observed isomeric shifts were in accordance with the interpretation of Walker. Even for $Fe^{3+}$ ions, large quadrupole splittings were found. The analysis of the spectrum of tourmaline was similar to that of biotite. (auth)

**18145** IMPACT IONIZATION OF CENTERS IN SOLIDS BY ELECTRONS ACCELERATED BY AN ELECTRIC FIELD. F. Cardon (Laboratorium voor Kristallografie en Studie van Vaste Stoffen, Ghent). Phys. Status Solidi, 3: 339-48(1963). (In English)

The probability of impact ionization of centers by electrons which were accelerated in an electric field was calculated using time dependent perturbation theory. The wave function for a bound electron was taken to be of the form $\psi = (\lambda^3/\pi)^{1/2} \exp(-\lambda r)$ and the effective mass approximation was used for the band. A modified Boltzmann function was used for the electrons in the band, and it is shown that impact ionization can only be important, in high resistivity materials, if the electric field is high even to raise the electron temperature well above lattice temperature. The effect on the current-voltage characteristic was examined for two simple cases and it was found that a steep rise due to impact ionization can occur. Electrons trapped in neutral centers are somewhat more important than electrons in negative centers, while electrons in positive centers are very much less important. It is also shown that the effect of impact ionization will, in general, only be important if most of the electrons which are released are trapped in other shallow traps. (auth)

**18146** COLORATION OF YTTRIUM-DOPED $CaF_2$ AND $SrF_2$ CRYSTALS BY X-RAY IRRADIATION. P. Goerlich, H. Karras, W. Luedke, H. Mothes, and R. Reimann. Phys. Status Solidi, 3: 478-84(1963). (In English)

$CaF_2$ and $SrF_2$ crystals were doped with trivalent yttrium ions, and x-irradiated, which resulted in similar coloration spectra for both substances. The bands seemed to satisfy Mollwo's relation $\nu a^2 = \text{const}$, since the $SrF_2$ bands were shifted to longer wavelengths compared with the corresponding $CaF_2$ bands. The absorption spectra were interpreted in terms of the 4d electrons of the bivalent yttrium ions, whose formation was explained by the reductive action of the x rays. The coloration spectra of the $CaF_2$/Y crystals were identical with the four-absorption-band spectra of natural crystals or synthetic crystals grown from natural material. This supports strongly the assumption that the four-absorption-band spectra in natural $CaF_2$ is produced by yttrium impurities; this however invalidates hypotheses according to which the four-absorption-band spectrum of $CaF_2$, obtained after irradiation, is typical of intrinsic lattice imperfections in alkaline earth fluorides. (auth)

**18147** COLOR CENTER FORMATION BY PULSE IRRADIATION OF ALKALI HALIDES. J. H. Schulman (Naval Research Lab., Washington, D. C.) and J. W. Boag. Phys. Status Solidi, 3: 516-22(1963). (In English)

Preliminary observation was made of the absorption spectra of four alkali halides (LiF, NaCl, KCl, and KBr) at various intervals after bombardment, at room temperature, with a 2 microsecond pulse of 2 Mev electrons. The absorption was measured spectrographically using an underwater uranium spark light source which can be triggered either "simultaneously" with the electron beam or after a predetermined delay of a few microseconds or longer. In addition to the expected intense and persistent F-bands, transient absorption bands in the ultraviolet were observed in all cases, some with lifetimes of the order of a few tens of microseconds at room temperature, and others which persisted along with the F-band. These transient bands appeared to be due to trapped-hole centers such as the $V_K$-, H-, or $V_1$-centers, which previously were observed only at low temperatures. (auth)

**18148** PROBLEMS OF APPARATUS FOR RADIOCHEMICAL PROCESSES. A. Ch. Breger (Karpov Inst. of Physics and Chemistry, Moscow). Przemysl Chem., 41: 612-19(Nov. 1962). (In Polish)

The role of nuclear radiation in the development of radiochemistry is reviewed from the point of view of process types and the demand that each type makes on radiochemical apparatus. Installations for radiochemical research are covered and in particular, the series K installations are tabulated as to their source strengths. These vary from about 300 grams radium-equivalent of $Co^{60}$ to about 45,000 grams radium-equivalent. Special installations for carrying on radiochemical processes on a larger scale are discussed, as are the basic needs for the setting up of the apparatus, the basic technological characteristics of the radiation apparatus, and the effectiveness or yield of a radiation facility. 61 references. (TTT)

**18149** PRODUCTION OF RADIOISOTOPES OF NIOBIUM BY IRRADIATION OF ZIRCONIUM WITH PROTONS. Kazuo Saito (Tokyo Univ.), Shin Suzuki, and Makoto Saito. Radioisotopes (Tokyo), 12: 6-10(Feb. 1963). (In Japanese)

For the purpose of obtaining neutron-deficient radioisotopes of niobium to be used for the study of decay scheme and for carrier-free tracer, separation of niobium from irradiated zirconium was examined by solvent extraction and radio-colloid formation. Extraction of niobium fluoride with methyl-iso-butyl ketone was successful, but the extraction was retarded in the absence of carrier. Extraction with chloroform in the presence of tribenzylamine in concentrated hydrochloric acid solution appeared to be most useful for a practical production. Back-extraction was substantiated with various solutions including mineral acid, caustic alkali, and hydrogen peroxide. To remove the last trace of ingredients in the aqueous solution, radiocolloid formation in concentrated caustic alkali or ammonia solution and re-dissolution in hydrochloric acid were very useful. The product consisted only of isotopes of niobium and was used for the carrier-free source. Hafnium, always present in natural zirconium, gave radioisotopes of tantalum, but they did not vitiate the measurement of radioactivity of niobium isotopes. (auth)

**18150** RADIATION-INDUCED GELATION OF DILUTE AQUEOUS PECTIN SOLUTIONS. I. J. Wahba, D. F. Tallman, and L. M. Massey, Jr. (Cornell Univ., Geneva, N. Y.). Science, 139: 1297-8(Mar. 29, 1963).

Low-dose gamma irradiation of dilute aqueous pectin so-

lutions after appropriate adjustment of pH with hydrochloric or certain other inorganic acid led to the formation of thermoreversible gels. Maximum gel strength was attained only under optimum conditions of pH, concentration, temperature, radiation dose, and exposure time, and only in the absence of oxygen and a number of radiation protectants. (auth)

**18151** GAMMA-RADIOLYSIS OF LIQUID ACETONE. R. Barker (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Trans. Faraday Soc., 59: 375-85(Feb. 1963). (AERE-R-3992)

The radiolysis of liquid acetone with $Co^{60}$ $\gamma$ radiation at a ambient temperature was investigated and an attempt made to measure all of the products formed over a wide dose range. Product distribution indicates that carbon-carbon and carbon-hydrogen bonds are broken, but there is little attack on the carbonyl group. The results can be interpreted using radical reactions only if it is postulated that some of these occur in spurs. Ion-molecule reactions and unimolecular dissociation of excited molecules appear to play little part in the overall mechanism. (auth)

**18152** CHEMISORPTION OF METAL OXIDES. PART 2. NEUTRON-IRRADIATED NICKEL OXIDE AND MAGNESIUM OXIDE. H. B. Charman and R. M. Dell (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Trans. Faraday Soc., 59: 470-84(Feb. 1963).

A study was made of the interaction of oxygen, hydrogen, and nitrous oxide with samples of nickel oxide and magnesium oxide which had been pre-irradiated with fast neutrons in a nuclear reactor up to doses of $6 \times 10^{19}$ neutrons/$cm^2$. The irradiated oxides possess a high concentration of defects and those near the surface give rise to an enhanced chemisorption of oxygen and hydrogen. The kinetics of the chemisorption process are studied at room temperature and 150°C. Similar results are obtained for both oxides, suggesting that it is the nature of the defects rather than the electronic structure of the cations which determines the chemisorptive properties of neutron irradiated oxides. The thermal annealing of the adsorption centers is measured and a tentative assignment is made of oxygen chemisorption to two different types of metal-excess center and of hydrogen adsorption to oxygen-excess centers. Although some influence of pre-irradiation on $N_2O$ decomposition is observed, it is concluded that this reaction is not suitable as a means of studying surface defects. (auth)

**18153** DIELECTRIC CHANGES AND THERMOLUMINESCENCE OF SODIUM CHLORIDE AND LITHIUM FLUORIDE IRRADIATED WITH X-RAYS. K. V. Rao (Indian Inst. of Tech., Kharagpu, India). Z. Physik, 172: 258-62(1963). (In English)

The dielectric changes exhibited by sodium chloride and lithium fluoride on heating after x-ray irradiation were measured at a frequency of 500 kc/sec. The thermoluminescence was recorded. It was observed that the dielectric loss of both the samples increases during thermal bleaching. The difference between the dielectric losses of the crystals before and after coloration i.e., $\Delta \tan \delta$, for different stages of thermal bleaching was found to show steps, the temperature regions of which agree with the temperatures of the glow peaks. It is presumed that this observed excess dielectric loss is due to the large number of vacancies created by the destruction of color centers at the corresponding glow peak temperatures. (auth)

**18154** THE $^{60}Co$ $\gamma$-RAY RADIOLYSIS OF ACRIDINE ORANGE NO IN AQUEOUS SOLUTIONS. N. Th. Rakintzis, D. G. Marketos, and A. P. Konstas (Nuclear Research Center Democritus, Aghia Paraskevi-Attikis, Athens). Z. Physik. Chem. (Frankfurt), 35: 234-46(Dec. 1962). (In English)

Aqueous solutions of Acridine orange (AO) were irradiated with $Co^{60}$ $\gamma$ rays in the presence and in the absence of oxygen. In the first case only irreversible decoloration of the dye was observed, due to the oxidative action of two OH radicals per molecule of the dye. Upon irradiation of air-free solutions a recovery was observed on admission of air to the extent of 65%. The reversible decoloration in this case is attributed to reduction caused by two H atoms per molecule of the dye. The decoloration yield in the presence of air was found to be independent of the concentration of the dye, the pH of the solution, and the $\gamma$ dose-rate, within a wide range, and equal to $1.25 \pm 0.05$. The behavior of the system against the radiation in the presence of some selected scavengers (dextrose, ferric nitrate, 2,5-dichlorohydroquinone, and formic acid) in aerated as well as in deaerated solutions was further investigated. The ultraviolet and visible spectra of irradiated and non-irradiated samples were finally studied. The results were interpreted on the basis of reactions with the free radicals produced from water. (auth)

**18155** MEKHANIZM RADIATSIONNO-KHIMICHESKIKH REAKSTII. (The Mechanism of Radiochemical Reactions). S. Ya. Pshezhetskii. Moscow, State Scientific-Technical Publishing House of Chemical Literature, 1962. 360p.

A survey was made of data on the mechanism of radiochemical reactions covering published literature up to 1962. The survey includes the mechanism of chemical processes induced by nuclear and other ionizing radiations. Elementary processes induced by irradiation of molecules and radiochemical processes in inorganic and organic compounds are analyzed. The singularities of radiochemical reactions in gaseous, liquid, and solid phases are also discussed. Extensive references are included at the end of each chapter. (R.V.J.)

**18156** PROCESS FOR HYDROCARBON CONVERSION. Hillis O. Folkins (to Pure Oil Co.). U. S. Patent 3,083,152. Mar. 26, 1963. Filed May 27, 1959.

A process is outlined for selectively dehydrogenating low-molecular-weight hydrocarbons. The process comprises subjecting the hydrocarbons at 800 to 1200°F to 500 to 500,000 r of high-energy ionizing radiations while in contact with metal vapor or dispersed metal particles selected from group IA, IIB, IIIB, IVB, and VIIIB metals. (D.L.C.)

## Raw Materials and Feed Materials

**18157** (ANL-6606) A FLUID-BED PROCESS FOR THE DIRECT CONVERSION OF URANIUM HEXAFLUORIDE TO URANIUM DIOXIDE. I. E. Knudsen, H. E. Hootman, and N. M. Levitz (Argonne National Lab., Ill.). Feb. 1963. Contract W-31-109-eng-38. 45p.

A new, dry process for the production of $UO_2$ powder from $UF_6$ by fluidization and particle-coating techniques was developed. The process involves direct conversion of $UF_6$ to a solid, $UO_2F_2$, by hydrolysis with steam and the reduction of the $UO_2F_2$ to the dioxide by reaction with steam-and-$H_2$ mixtures. Development work on the process was carried out in 3-in.-dia. Monel reactors. In continuing studies, dense, spheroidal $UO_2$ particles in the range −20 +200 mesh are being prepared. A simultaneous (steam and $H_2$) reaction procedure at temperatures up to 700°C is being used. Particle densities ranged to 9.75 g/cc or about 89% of theoretical. Sintering in $H_2$ at about 1700°C for 2.5 hr gave final densities of 10.4 to 10.6 g/cc or up to about 96.5% of theoretical density. (auth)

**18158** (HW-69738) PARAMETERS IN THE CONVERSION OF PLUTONIUM NITRATE TO PLUTONIUM TRICHLORIDE BY A DIRECT CALCINATION— FLUID BED CHLORINATION PROCESS. M. J. Rasmussen, G. L. Stiffler, and H. H. Hopkins, Jr. (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). May 31, 1961. Contract AT(45-1)-1350. 17p.

Results of studies of the known parameters for direct calcination of plutonium nitrate in an agitated bed and conversion of $PuO_2$ to $PuCl_3$ by fluid bed processes are presented. A description of the processes and the demonstration equipment is included. The study of variables is discussed along with the parameters and plans for demonstration runs. (J.R.D.)

**18159** (HW-SA-2697) STUDIES ON THE ELECTROREDUCTION OF URANYL(VI) IN MOLTEN EQUIMOLAR KCl–NaCl BY CHRONOPOTENTIOMETRIC AND ELECTRODE IMPEDANCE MEASUREMENTS. R. W. Stromatt (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). [Aug. 28, 1962]. Contract AT (45-1)-1350. 19p.

Results of the studies indicate that there is a $UO_2(V)$ intermediate which is subsequently reduced to stable $UO_2$. The reaction is diffusion controlled. The diffusion coefficient for the $UO_2(VI)$ ion is comparable to Delemarskii's values for Cd(II) and Ni(II). The rate constant of $UO_2(VI)$ to $UO_2(V)$ is very large. (J.R.D.)

**18160** (NP-12670) REPORT OF THE NUCLEAR FUEL REPROCESSING STUDY TEAM. G. Ooyama (Nuclear Fuel Reprocessing Study Team). Sept. 30, 1961. 80p. (In Japanese)

Plans were prepared in Japan for the design and construction of nuclear fuel reprocessing plants corresponding to the proposed atomic power generation schedule of 1000 Mw in 1971 and 6000 to 8500 Mw by 1981. A team was therefore sent to United States, United Kingdom, France, and Belgium during April and May 1961 for studying the technical processes used and experience gained from operating fuel reprocessing plants and to obtain information on plant design and maintenance problems. Attention was paid also to the shipment of spent fuels and the safe disposal of radioactive waste streams. Other problems considered included criticality control, accountability of fissionable materials, radiation safety, and financial questions involved in the construction and operation of the plants. The team visited 31 locations, including government installations and private facilities. Research laboratories, reprocessing plants, power stations, fuel fabrication plants, and consulting firms were included in the list of facilities visited. The present status of the fuel reprocessing industry in these countries from engineering and economic viewpoints is outlined and an accelerated study on the domestic use of fissionable materials is recommended, pointing out that the recovered Pu and $U^{235}$ cannot be sold back to the U. S. and the U. K. The importance of further study of the waste treatment, under consideration of the specific geographic and problems encountered in Japan, is strongly emphasized. (TTT)

**18161** (PG-Report-379) METHOD FOR THE CONVERSION OF URANIC MATERIALS TO URANIUM HEXAFLUORIDE, FOR ISOTOPE ABUNDANCE MEASUREMENT. (United Kingdom Atomic Energy Authority. Production Group, Springfields, Lancs, England). 1963. 27p.

The apparatus is designed to allow fluorination of variously enriched samples without intersample contamination taking place. All samples are first converted to oxide. The oxide is fluorinated by $ClF_3$. The $UF_6$ product is purified, then sealed under vacuum in a breakseal tube for attachment to the mass spectrometer. (auth)

**18162** CHEMICAL CONCENTRATION OF URANIUM ORES. R. Gautier. Energie Nucl., 4: 600-6(Dec. 1962). (In French)

The chemical method described at the Second Geneva Conference has received industrial confirmation. The technical developments were accomplished, and the chemical procedure using lime as the concentration agent has confirmed its value. The process has great flexibility with respect to different ores and allows an almost selective attack on uranium. The primary concentrates obtained are 20 to 30% in metal and are particularly suitable for obtaining nitrate solutions, which lead directly to the very pure salt by treatment with TBP-based solvent. (tr-auth)

**18163** TREATMENT OF EFFLUENTS AND RECOVERY OF URANIUM. W. Haegi. Energie Nucl., 5: 26-30 (Jan.-Feb. 1963). (In French)

The effluents coming from the factories treating uranium ores are of sizable quantities but their radioactivity is generally low (unless one is dealing with rich ores) whereas the effluents resulting from uranium refining are of smaller volume but contain chiefly uranium; this must be eliminated because of its noxiousness and, moreover, its recovery is important from the economic point of view. Particular consideration is given to the effluents and residues which result from the uranium refining operations at the Narbonne factory; the basis of their treatment carried out at this same factory is also indicated. (auth)

**18164** DIRECT REDUCTION OF URANIUM HEXAFLUORIDE TO URANIUM METAL WITH SODIUM. Charles D. Scott (Oak Ridge National Lab., Tenn.). Ind. Eng. Chem., Process Design Develop., 2: 117-21(Apr. 1963). (ORNL-TM-92)

Thermodynamic considerations indicate that sodium should be favorable for the one-step reduction of $UF_6$ to uranium metal. A reaction vessel was developed for the continuous reduction of $UF_6$ to metal with batch collection of the products, and several experimental tests established the chemical feasibility of this direct and continuous reduction. Up to 93.5% of the uranium content of $UF_6$ continuously reduced by sodium in a reaction vessel was recovered as massive uranium metal in the form of a metal button of acceptable purity. A remaining problem is development of compatible materials of construction. (auth)

**18165** PLUTONIUM METAL FROM TRIFLUORIDE. Donald A. Orth (E. I. du Pont de Nemours and Co., Inc., Aiken, S. C.). Ind. Eng. Chem., Process Design Develop., 2: 121-7(Apr. 1963).

Plutonium trifluoride can be precipitated from a plutonium(III) nitrate solution, dried, and reduced to metal using calcium with an iodine booster. This system, with variations, has been in routine use at the Savannah River Plant for several years to produce 2000-gram buttons of plutonium metal. Criteria that determine crystal size and filtrate loss during precipitation in a two-stage unit appear applicable to the design and operation of multistage units for the precipitation of other compounds. The low heat of reduction of the trifluoride requires 0.6 mole of iodine per mole of plutonium as a booster for good yields. Problems caused by iodine are eliminated by oxidizing anhydrous $PuF_3$ with dry oxygen to a mixture of $PuF_4$ and $PuO_2$, which has sufficient heat of reduction to be reduced with calcium alone, in 96% yield. General relationships between plutonium fluorides and oxides, the role of hydrated tetrafluorides, and filtrate recovery are discussed. (auth)

**18166** ELECTRODEPOSITION OF PLUTONIUM AND URANIUM FROM MOLTEN SALT SOLUTIONS OF DICHLORIDES. M. B. Brodsky and B. G. F. Carleson (Argonne National Lab., Ill.). J. Inorg. Nucl. Chem., 24: 1675-81(Dec. 1962).

The usefulness of molten salt solutions of $Cs_2PuCl_6$ and $Cs_2UCl_6$ for plutonium and uranium electrolyses was investigated. Plutonium and uranium metal were recovered from solutions without the use of soluble anodes. Up to 66 per cent of the Pu dissolved in salt solutions was recovered with Ta cathodes. No net Pu was recovered from solution when Pu cathodes were used because of the reoxidation of the deposit by dissolved chlorine. Uranium metal was deposited on molten lead and solid molybdenum cathodes with high yields. The decomposition potentials for Pu(III)–Pu(O) and U(III)–U(O) were found to be in agreement with previous results for solutions of $PuCl_3$ and $UCl_3$. (auth)

**18167** CHEMICAL REACTIVITY OF URANIUM TRIOXIDE. PART 2. $UO_3$ HYDRATES. R. M. Dell and V. J. Wheeler (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Trans. Faraday Soc., 59: 485-502(Feb. 1963).

The preparation and decomposition of the hydrates of uranium trioxide are considered. The reactivity of $UO_3$ prepared by decomposition of these hydrates towards reduction to $UO_2$ and further conversion to $UF_4$ is studied as a function of the hydration-dehydration parameters. The hydration at 20 to 100°C of "fluidized-bed" $UO_3$ proceeds at different rates in liquid water and in water vapor, and different hydrates may be formed at the same temperature in metastable states. Three different monohydrates were identified and evidence is presented for the existence of two dihydrates. Hydration leads to a substantial volume expansion which is retained on subsequent dehydration, leaving $UO_3$ in an expanded porous form. Initially, the product contains amorphous $UO_3$ which recrystallizes exothermically to $\gamma UO_3$ at ~500°C. Reduction of $UO_3$ prepared from the hydrates proceeds uniformly throughout the particle and is associated with a volume contraction. The reactivity of the product $UO_2$ towards hydrofluorination depends upon (i) the hydrate phase used, (ii) the conditions of the hydration process, (iii) the temperature of dehydration and reduction to $UO_2$. This dependence is analyzed in detail and a model is proposed for the sub-particle structure of the $UO_2$ which adequately accounts for its reactivity pattern. (auth)

**18168** CONTROL OF MOLYBDENUM DURING LIQUID-LIQUID EXTRACTION OF URANIUM USING AMINE EXTRACTANTS. James L. Drobnick and Clifford J. Lewis (to General Mills, Inc.). U. S. Patent 3,083,076. Mar. 26, 1963. Filed June 5, 1959.

A process for the extraction of U from its ores using amine extractants is described in which the appearance of green, Mo-containing interfacial solids in the amine extractant is prevented. Besides the usual steps of acid dissolution of the ore, amine extraction, and stripping of U, the process also includes a reducing step between the extraction and stripping steps, whereby Mo is kept from forming a complex with the amine. The reduction, which may be effected by $Na_2S$, increases the tolerance level of tertiary amines for Mo to the point where they may be used in place of secondary amines. (D.L.C.)

## Separation Processes

*Refer also to abstract 18176.*

**18169** (AERE-AM-92) THE SEPARATION OF RADIOBARIUM AND RADIOSTRONTIUM FROM SOLUTIONS CONTAINING SULPHURIC ACID. J. W. McMillan (United Kingdom Atomic Energy Authority. Research Group. Chemistry Div., Woolwich Outstation, England). Feb. 1963. 7p.

The exchange of radiobarium and radiostrontium with Ba and Sr carriers is achieved by dissolution of the sulfates in strong sulfuric acid. The sulfates are precipitated by dilution of the solution with water, and, after dissolution in ammoniacal E.D.T.A., the carbonates are precipitated by the addition of excess sodium carbonate and ferric nitrate. Precipitation of the nitrates by addition of fuming nitric acid is followed by an Fe scavenge and separation of the Ba and Sr by precipitation of barium chromate. The Ba and Sr analyses may be completed as described in AERE-AM 65 and AERE-AM 3 respectively. (auth)

**18170** (AERE-R-3124) THE EXTRACTION OF ACIDS BY TRI-n-BUTYLPHOSPHATE (TBP). C. J. Hardy (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Oct. 1959. 23p.

The nature of the species present in TBP phases containing TBP, $H_2O$, and HX or $H_2X$ (where HX is a monobasic acid and $H_2X$ a di-basic acid) was critically reexamined, and the following main species are postulated: TBP·$H_2O$ molecules, TBP·$H^+(H_2O)_{n_1}$ ions, $X^{\cdot\cdot}(H_2O)_{n_2}$ (or $HX^-(H_2O)_{n_2}$ for a dibasic acid) ions, TBP·$H^+(H_2O)_{n_1}\cdot X^{\cdot\cdot}(H_2O)_{n_2}$ ion-pairs, TBP·HX molecules, and HX molecules. The concentrations of these species are plotted against $C_{HX}$, the total molar concentration of the acid in the TBP phase, for perchloric, hydrochloric, sulfuric, and nitric acids up to values of $C_{HX}$ of 2.8, 3.4, 3.7, and 5.9 respectively. (auth)

**18171** (AERE-R-4219) TESTS ON ABSORBERS FOR IODINE AT LOW CONCENTRATIONS. J. B. Morris and C. H. Rumary (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Feb. 1963. 63p.

A room (volume = 1,500 $m^3$) was used as the working volume in which low iodine concentrations for test purposes were generated. Various carbons, gas coke, copper and silver metal, wet scrubbers, filters, and double systems (absorber + filter) were tested for their iodine removal properties. Although the iodine concentration in the room decreased with time in each run, the exit concentration from the system under test was sensibly constant, and on this basis the various systems were compared. Carbon was the best absorber, and it was improved still further when combined with a filter. Gas coke and oxidized copper were unsatisfactory on account of their low absorption capacity. Iodine on copper was readily exchangeable, that on coke partially so, but that on carbon was not exchangeable. Part of the iodine released into the laboratory became attached to suspended particulate matter, and part was converted to a non-elemental vapor form. The latter fraction appeared to vary from run to run and its presence seemed to be the chief cause of the different performances of the various types of absorbers. (auth)

**18172** (DP-371) FLOW CHARACTERISTICS OF A CIRCULAR WEIR IN A CENTRIFUGAL FIELD. Donald S. Webster (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.); Clifton L. Williamson and James F. Ward (Du Pont de Nemours (E. I.) & Co. Savannah River Plant, Aiken, S. C.). June 1961. Contract AT (07-2)-1. 23p.

The mixing and settling required for solvent extraction between liquid phases can be accomplished in a relatively small volume by a centrifugal contactor in which intense mixing is followed by separation of phases in a centrifugal field. Circular weirs, concentric with the axis of rotation,

are used to set the overflow radii of the two liquid phases at positions that will cause the emulsion to float evenly in the disengaging section. For accurate control, the flow characteristics of the circular weirs must be known. An equation was developed for circular weirs by analogy to the relations for a simple weir, and the appropriate weir coefficients were evaluated empirically by experiments with both a steel contactor and a transparent plastic contactor. A correlation of the experimental coefficients was developed to allow calculation of general weir performance. (auth)

**18173** (DP-447) ANION EXCHANGE RECOVERY OF PLUTONIUM FROM REDUCTION RESIDUES. Edwin R. Russell (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). Feb. 1960. Contract AT(07-2)-1. 12p.

An anion exchange process was demonstrated for the recovery of Pu from waste produced in the reduction of Pu salts to the metal. Pu in a highly salted 6M nitric acid solution, derived from the dissolution of slag and crucible waste, was separated from impurities by absorbing the Pu(IV) nitrate complex on the anion exchange resin and subsequently eluting with dilute nitric acid. A flowsheet for plant operation is presented. (auth)

**18174** (DP-580) RECOVERY OF PLUTONIUM FROM METALLURGICAL REDUCTION RESIDUES. E. Kenneth Dukes and William E. Prout (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). June 1961. Contract AT(07-2)-1. 16p.

A semicontinuous process was developed for dissolving the solid residues that are produced in the Ca-reduction process for converting plutonium fluoride to plutonium metal. The slag and crucible residues are charged to a column-type dissolver and are there exposed to a flowing solution of hot nitric acid followed by a nitric acid–aluminum nitrate solution. The resultant solution is suitable as feed to an ion exchange process for recovering Pu. A method was demonstrated for recovering Pu from the dissolver solution by anion exchange in agitated beds of resin. The use of agitated beds of resin eliminates the need for filtering the feed. (auth)

**18175** (HW-SA-2959) AMINE SYSTEMS IN SOLVENT EXTRACTION. W. E. Keder, A. S. Wilson, and L. L. Burger (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). [Apr. 3, 1963]. Contract [AT(45-1)-1350]. 32p.

Discussions are presented concerning characteristics of the organic phase in amine solvent extraction and of properties of the species present when simple inorganic acids and actinides are extracted. The effects of amine structures and diluents are examined along with the nature of the organic phase, metal extraction, and aggregation of complexes. (J.R.D.)

**18176** (IDO-14603) THE IN-LINE ANALYSIS OF ELECTROLYTIC DISSOLVER SOLUTIONS FOR NITRIC ACID AND SALT CONCENTRATIONS. D. P. Pearson (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). Mar. 7, 1963. Contract AT(10-1)-205. 10p.

Two instruments were developed for simultaneous in-line analysis of nitric acid and salt concentrations in electrolytic dissolver product solutions. Two measurements are required in each case. The dual conductance analyzer measures two electrolytic conductances, those of the product solution and a known volume dilution of this product. The second method is based upon a conductance and a density measurement of the undiluted solutions. The instruments were applied to an operating dissolver system, and the results agreed with standard analyses with a standard deviation of ±0.2 equivalent per liter for both components. (auth)

**18177** (NAA-SR-7660) REPROCESSING OF URANIUM CARBIDE BY MOLTEN SALT ELECTROLYSIS. W. N. Hansen (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Mar. 15, 1963. Contract AT(11-1)-Gen-8. 20p.

A new method for reprocessing UC was proposed and demonstrated on a laboratory scale. The reprocessing steps include fused salt electrolysis of UC, dissolution of the dendritic U deposit in hot Hg, and conversion of the U in the quasi-amalgam to UC by distillation in a hydrocarbon gas atmosphere. Approximate decontamination factors at one throughput, observed on a tracer scale, are, for Sr, Ba, rare earths, Ce, Ru, and Zr, $10^4$, $10^3$, $10^3$, $10^2$, $10^3$, and 1, respectively. (auth)

**18178** (ORNL-3203) PURIFICATION OF DEGRADED TRIBUTYL PHOSPHATE–HYDROCARBON DILUENT SOLUTIONS BY DISTILLATION: STATUS SUMMARY. W. Davis, Jr. (Oak Ridge National Lab., Tenn.). Dec. 13, 1961. Contract W-7405-eng-26. 15p.

Molecular distillation and rapid, nonrefluxing volatilization at ~0.5 mm Hg pressure successfully purified TBP—Amsco 125-82 solutions that had been extensively degraded by irradiation in a $Co^{60}$ gamma source or by use in fuel processing in the ORNL Pilot Plant. Distillation at ~50 mm Hg with reflux produced large amounts of tar in the still pot. Infrared analyses of the products of both molecular and rapid distillation showed that the degradation products which are important in subsequent performance of recovered solvent-diluent solutions have higher boiling points than TBP and are primarily nitro compounds. A continuous flash distillation unit was designed to purify degraded TBP—Amsco 125-82 solutions at a rate of 150 l/hr with a TBP loss ≤1% of that charged. Preliminary estimates indicate a capital cost of $202,400 for such a distillation unit erected in an existing building. This cost includes a moderate amount of shielding for the parts handling the bottoms product. The throughput of the column was set at 200 l/hr to ensure that an average of 150 l of solvent per hour can be handled over an extended time. The estimated operating cost is $0.02/l ($0.078/gal), exclusive of taxes, insurance, amortization, and general overhead, and $0.03 to 0.04/l ($0.11-0.15/gal.) including these fixed costs. (auth)

**18179** (ORNL-TM-358) A MATHEMATICAL MODEL FOR THE SOLVENT EXTRACTION OF URANYL NITRATE AND NITRIC ACID. M. H. Lietzke and R. W. Stoughton (Oak Ridge National Lab., Tenn.). July 10, 1962. Contract [W-7405-eng-26]. 26p.

A generalized least-squares technique can be used to calculate equilibrium constants in solvent extraction equilibria by minimizing the difference between observed and calculated distribution ratios. The method was successfully applied to the extraction of uranyl nitrate and nitric acid by TBP dissolved in an inert diluent. (auth)

**18180** (TID-16595) ION-EXCHANGE BEHAVIOR OF THE TRANSURANIUM ELEMENTS IN $LiNO_3$ SOLUTIONS. S. Adar, R. K. Sjoblom, R. F. Barnes, P. R. Fields (Argonne National Lab., Ill.), E. K. Hulet, and H. Wilson (California. Univ., Livermore. Lawrence Radiation Lab.). May 1962. Contract [W-31-109-Eng-38]. 13p. (UAC-6498)

The distribution coefficients of trivalent Pu, Am, Cm, and Cf between $LiNO_3$ solutions (containing (0.005 M $H^+$) and Dowex-1 anion resin were measured. A column separa-

tion of Am and Cm using this system was investigated at 22.5 and 87°C. The separation factor was found to be higher than that obtained with an ammonium alpha-hydroxisobutyrate-cation column system. (auth)

**18181** (TID-18290) SEPARATION OF TECHNETIUM-99 FROM URANIUM HEXAFLUORIDE. W. R. Golliher, R. A. LeDoux, S. Bernstein, and V. A. Smith (Union Carbide Nuclear Co. Paducah Plant, Ky.). [196?]. Contract W-7405-eng-26. 15p.

A system is described for recovery of Tc from $UF_6$ in a $UO_3$ fluorination plant. The Tc is retained on $MgF_2$ in traps through which the $UF_6$ stream is passed. The system is in operation at the Paducah Gaseous Diffusion Plant. (J.R.D.)

**18182** (TID-18299) ORGANOPHOSPHORUS COMPOUNDS, OTHER THAN TBP, FOR PROCESSING OF IRRADIATED FUELS AND BY-PRODUCTS. T. H. Siddall, III (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). [Mar. 1963]. Contract AT(07-2)-1. 39p.

A brief general discussion is given of the nomenclature and types of organophosphorus compounds that could be useful for aqueous processing of irradiated fuels and by-product isotopes. Comments are made on the use of compounds that might give substantial process gains even though the compounds may not be readily available. Application of alternative extractant-diluent systems is examined for simultaneous recovery of U and Pu (Purex), simultaneous recovery of $U^{233}$ and Th (Thorex), and recovery of U alone (enriched uranium or "25"). Recovery of by-product elements such as Pm, Am, and Cm is discussed with particular emphasis on the possible use of bifunctional organophosphorus extractants. A discussion is given of a number of specific types of compounds that are of interest to future investigations. These compounds are chosen on the basis of unusual structure, possible effects on synergistic relationships, interesting theoretical possibilities, and practical potential. A brief discussion is given of the powerful synthetic techniques developed over the last few years that make such a wide range of compounds potentially available for study. (auth)

**18183** (AEC-tr-5729) EXTRACTION OF CESIUM FROM AQUEOUS SOLUTIONS BY A NITROBENZENE SOLUTION OF DIPICRYLAMINE. M. Kyrš (Kyrsh), J. Pelčík (Pelchik), and P. Polanský (Polanski). Translated for Oak Ridge National Lab., Tenn. from Coll. Czech. Chem. Commun., 25: 2642-50(1960). 17p.

Extraction of Cs from aqueous alkaline solutions by nitrobenzene in the presence of dipicrylamine is investigated. Factors which affect the Cs distribution between these two phases are examined along with optimum conditions for rapid Cs separation from the majority of long-lived fission products and U. (J.R.D.)

**18184** (UCRL-Trans-898(L)) SEPARATION OF MOLYBDENUM AND IRON BY ION-EXCHANGE CHROMATOGRAPHY. I. P. Alimarin and A. M. Medvedeva. Translated by Sergey Shewchuck (Univ. of California. Lawrence Radiation Lab., Livermore) from Tr. Komis. po Analit. Khim., Akad. Nauk SSSR, Inst. Geokhim. i Analit. Khim., 6: 351-64(1955). 17p.

Molybdenum was separated from trivalent iron by the ion exchange method in the presence of acetic acid with the pH of the solution being equal to ~ unity. From bivalent iron, the molybdenum was separated in a broader interval of pH (1.0 to 3.0). The difference in the sorption ability of the bivalent and trivalent iron from solution containing acetic acid is explained by the different stability of the citrate complexes of the bivalent and trivalent iron. Molybdenum was also separated from iron by ion exchange in the presence of hydrogen peroxide in which the iron ions are sorbed by the cationite, and molybdenum passes into the filtrate in the form of a complex anion. These methods were also used for separation of molybdenum and iron for analysis of steel, iron ore, and ferromolybdenum. (H.G.G.)

**18185** THE EXTRACTION OF THE LANTHANIDE ELEMENTS FROM PERCHLORIC ACID BY DI-(2-ETHYLHEXYL) HYDROGEN PHOSPHATE. T. B. Pierce and P. F. Peck (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Analyst, 88: 217-21(Mar. 1963).

The elements lanthanum, cerium, praseodymium, neodymium, promethium, samarium, europium, gadolinium, terbium, dysprosium, holmium, erbium, thulium, ytterbium, lutetium, and yttrium were extracted from an aqueous perchlorate phase at different acidities into a solution of di-(2-ethylhexyl) hydrogen phosphate in toluene. Separation factors for all the elements of the lanthanide series were calculated, and the average value for nearest neighbors was found to be $2.40 \pm 0.87$. The extraction behavior of yttrium was found to be between that of holmium and erbium. (auth)

**18186** THE ORIENTATION OF CHEMICAL RESEARCH ON THE TREATMENT OF IRRADIATED FUEL. P. Regnaut. Bull. Inform. Sci. Tech. (Paris), No. 66, 3-5(Nov. 1962). (In French)

The program of the French CEA in this domain is determined by three main factors: the present five year plan, the cost of retreating, and safety considerations. The development of the systems gas-graphite, heavy water, fast breeders, demands ever increasing fuel qualities. The retreatment must take this progress into account, either by adapting the old methods or by devising new ones. In order to make energy of nuclear origin competitive, it is necessary to bring its cost price into line with that of conventional energy sources. The retreatment is an inevitable part of the fuel cycle and a big effort must be made in order to reduce its actual very high cost. Finally, it is necessary to bear continually in mind the question of the safety, not only of the plant workers but also of the surrounding population. This consideration poses difficult problems concerning the planning of the actual plants and especially the gaseous and liquid effluents and the extensed storage of radioactive waste. (auth)

**18187** TECHNICAL REVIEW OF THE 4 YEARS OPERATION OF THE IRRADIATED FUEL TREATMENT PLANT AT MARCOULE. Cl. Jouannaud. Bull. Inform. Sci. Tech. (Paris), No. 66, 6-10(Nov. 1962). (In French)

Four years operation of the Irradiated Fuel Treatment Plant at Marcoule are reviewed. The experience acquired in the design of the chemical installations is discussed both from the technological point of view and from that of the process and industrial development. This experience shows the advantages of a continuous process and of a simplification of the installations in order to make them more robust. The separation processes for plutonium, for uranium and for fission products are described. (auth)

**18188** SOLVENT EXTRACTION AT THE PLUTONIUM EXTRACTION PLANT AT MARCOULE. M. Chambon and J.-M. Reneaud. Bull. Inform. Sci. Tech. (Paris), No. 66, 11-17(Nov. 1962). (In French)

The separation process for the nitrates of plutonium, uranium, and fission products starting from the solution obtained by dissolution of the irradiated fuels (non-alloyed uranium) is described. Its principle is the selective extraction of the nitrates of tetravalent plutonium and hexavalent uranium in diluted tributylphosphate. The extraction

is carried out in mixer-decanters with natural circulation, the separation effected makes it possible to collect each of the nitrates individually for ultimate concentration and purification. (auth)

**18189** THE OPERATION OF THE PLANTS FOR THE PURIFICATION AND METALLURGY OF PLUTONIUM AT MARCOULE. R. Riolfo. Bull. Inform. Sci. Tech. (Paris), No. 66, 18-24(Nov. 1962). (In French)

The principles of the process used for the purification and the metallurgy of plutonium at Marcoule are given. The improvements made to the apparatus and to the process during 4 years operation are described. These modifications, only slight in the case of the process itself concerned especially the construction of the active circuits and the use of control instruments. (auth)

**18190** THE CONTROL LABORATORY OF THE PLUTONIUM EXTRACTION PLANT AT MARCOULE. A. Fontaine. Bull. Inform. Sci. Tech. (Paris), No. 66, 25-30 (Nov. 1962). (In French)

Some of the obligations and difficulties of the analytical control of the process used for plutonium extraction are explained, with the use of applications as examples. Few of the methods can be classed as routine; chemical attention must be constant. Analytical methods must be developed further before the control can be considered entirely satisfactory. (auth)

**18191** THE IRRADIATED FUEL TREATMENT STUDY SERVICE. J. Sauteron. Bull. Inform. Sci. Tech. (Paris), No. 66, 31-5(Nov. 1962). (In French)

The irradiated fuel treatment study service has two sections. The chemical Engineering and radioactive pilot tests section carries out research at the Fontenay-aux-Roses laboratories. The irradiated fuel treatment pilot plant section studies, at Marcoule, at high activities and on a semi-industrial scale, the apparatus and techniques selected in the laboratory. The laboratory research is directed to the perfecting of the conventional solvent process, to the storage of fission products in the best conditions, to the so-called dry processes which make use of the volatility of uranium and plutonium hexafluorides, and to the technology of radioactive product handling. Most of this research is carried out for the plutonium extraction plants, or with a view to treating fuel for Rapsodie. Only the applications concerning the study of the dry processes are considered from a long-term point of view. (auth)

**18192** THE PROBLEM OF IRRADIATED FUEL TREATMENT IN TERMS OF THE EVOLUTION OF THE NATURE OF THE FUEL. P. Faugeras. Bull. Inform. Sci. Tech. (Paris), No. 66, 36-51(Nov. 1962). (In French)

The conventional process for irradiated fuel treatment is the Purex process which makes use of a tributyl phosphate extraction from a nitrate solution for eliminating the fission products from U and Pu, and for separating these two elements from each other. In France it is used for extracting the Pu from irradiated, non-alloyed uranium. The nature of the fuels and of their cladding is undergoing an important evolution. At the moment there is a tendency towards fuels containing inert elements in more or less high proportions (Mo, Al, Zr, etc.,) and often enriched in fissile materials ($U^{235}$ or Pu). The Purex process must be modified or complemented to meet the problems presented by the new fuels since these inert elements very often give extra difficulties during the chemical treatment. Furthermore, the high irradiation rates make the irradiated fuels sufficiently radioactive to make necessary important changes in the treatment conditions, for example, the solvent is decomposed by the radiations. There is also considerable danger due to the large amounts of fissile materials involved (criticality). In certain cases the application of the Purex process is so complicated and costly that the possibility is considered of replacing it by fundamentally different processes which might be more universal, simple, and less costly. In this respect, the so-called "dry processes" employing the volatility of U and Pu hexafluorides appear fairly promising. (auth)

**18193** THE TREATMENT OF IRRADIATED THORIUM. J. Travert. Bull. Inform. Sci. Tech. (Paris), No. 66, 52-7 (Nov. 1962). (In French)

The in-pile irradiation of natural thorium yields a fissile material: $U^{233}$. The treatment of irradiated thorium was the object of studies carried out on a small pilot-plant scale. The principle governing the various operations of the process used, the difficulties encountered, and the first results obtained are described. The $U^{233}$ loss was $2.5 \times 10^{-3}$ and that of thorium was $8 \times 10^{-3}$. The main difficulty was the decontamination of thorium and uranium of $Pa^{233}$. The final purification on ion-exchange resins makes this possible, however. (auth)

**18194** A NEW SOLVENT FOR PLUTONIUM EXTRACTION-TRILAURYLAMINE. A. Chesné. Bull. Inform. Sci. Tech. (Paris), No. 66, 58-64(Nov. 1962). (In French)

The extraction and purification methods for plutonium are essentially based at the moment on the use of tributyl-phosphate (TBP). A tertiary amine, trilaurylamine (TLA) was used on a laboratory scale with a view to obtaining performances at least comparable to those of TBP. Its use is recommended in the case of solutions having a high $\beta$-activity. A study of its extractive properties shows that it has a high selectivity in nitric solutions, even diluted, for plutonium and neptunium in their quadrivalent states. The high extraction coefficients for these two species make it possible to obtain high concentrations during the extraction-re-extraction cycle, as well as on a high purification. An original re-extraction method was developed at the CEN-FAR. It is based on the use of an aqueous sulphonitric solution. Tests on solutions from Marcoule, already purified by a TBP cycle, made it possible to verify results obtained in the equilibrium tests. It was thus possible to purify plutonium in a single extraction-re-extraction cycle, thus avoiding three operations: precipitation of the hydroxides, purification with tributylphosphate, and purification on an anion exchange resin. The possibility is also considered of the application of trilaurylamine to neptunium extraction. (auth)

**18195** THE TREATMENT OF IRRADIATED FUELS BY NON-AQUEOUS METHODS. M. Bourgeois. Bull. Inform. Sci. Tech. (Paris), No. 66, 65-72(Nov. 1962). (In French)

The so-called "dry" processes make use of the volatilities of uranium and plutonium hexafluorides to separate these elements from their fission products. The fluoration of the fuels can be carried out either in the liquid or the gaseous phase. The liquid phase process uses a $ClF_3HF$ mixture which is made to react at 80°C. The hexafluoride, $UF_6$, liberated is then separated from the other voltatile fluorides (traces of fission products, $MoF_6$) by distillation, while the plutonium remains in the reaction apparatus in the form of $PuF_4$, with the great majority of the fission products. The gaseous phase process uses the acids HF or HCl to transform the cladding and the elements alloyed to

the uranium into voltatile products, and then uses fluorine to transform the intermediary uranium compounds into $UF_6$. The fuel is placed in an fluidizing bed of alumina which regularizes the thermal exchanges. In both cases it is possible to consider the possibility of recovering plutonium in the form of $PuF_6$. This would call for an extended study of the formation and reduction conditions of this compound, as well as of the $UF_6/PuF_6$ separation. (auth)

**18196** SOLVENT EXTRACTION IN IRRADIATED FUEL PROCESSING. X. Talmont and P. Leroy. Bull. Inform. Sci. Tech. (Paris), No. 66, 80-5(Nov. 1962). (In French)

After a comparison of the different processes used for the treatment of irradiated fuels using solvent extraction, the main chemical aspects of the treatment of uranium-based fuels by tributylphosphate extraction are outlined. The possibility of using this solvent for plutonium based fuels is considered. (auth)

**18197** SOLVENT EXTRACTION OF INORGANIC SPECIES. Y. Marcus (Israel Atomic Energy Commission, Rehovoth). Chem. Rev., 63: 139-70(Apr. 1963).

A review of the solvent extraction of inorganic species is presented which covers the literature up to the beginning of 1962, with emphasis on the work published since the review by Diamond and Tuck. The review is restricted to equilibria between aqueous solutions and immiscible organic solvents; organic chelating agents are considered only briefly. A bibliography of 465 references is included. (D.L.C.)

**18198** A STUDY OF THE ATTACK OF URANIUM OXIDES AND ALLOYS IN GAS PHASE. ITS APPLICATION TO THE CASE OF IRRADIATED NUCLEAR FUEL ELEMENTS. P. Faugeras and M. Bourgeois (Commissariat à l'Energie Atomique, Paris). Energie Nucl., 5: 16-25(Jan.-Feb. 1963). (In French)

This study concerns uranium recovery as hexafluoride from nuclear fuels, in particular from sintered U–Mo and $UO_2$ alloys. The attack of U–Mo is carried out in two stages: the first one is the conversion, either into an oxide through the action of $HCl$-$O_2$ mixtures at temperatures above 300°C, or into oxifluorides through the action of $HF-O_2$ mixtures at temperatures higher than 220°C; then these intermediate compounds are attacked by fluorine. Sintered $UO_2$ is directly attacked by fluorine. The process has the advantage of operating in gas phase, with appreciable reaction rates and negligible uranium losses. Another advantage, the majority of the molybdenum is removed from U–Mo alloys. (auth)

**18199** MUTUAL SEPARATION OF YTTRIUM-91 AND PROMETHIUM-147 BY COUNTERCURRENT SOLVENT EXTRACTION IN PULSE COLUMN. M. A. Mandil, G. W. Mason, and D. F. Peppard (Argonne National Lab., Ill.). Ind. Eng. Chem., Process Design Develop., 2: 106-12(Apr. 1963).

Continuous solvent extraction was proved satisfactory in separating $Y^{91}$ from $Pm^{147}$, using synthetic mixtures of the pair of nuclides. The separation was conducted in a compound perforated plate pulse column using 10% di(2-ethyl hexyl) phosphoric acid in toluene against an aqueous solution of $HNO_3$. One column volume change per hour was realized by appropriate choice of flow rates. Pulse frequency was maintained at 50 cycles per minute and pulse amplitude at 1 cm. The Pm : Y ratio in the feed was varied from 0.08 to 135. Pm in excess of 99% and Y in excess of 97% purity were obtained. Steady state was reached in 12 hours. The approach to steady state was the same for any one component in all runs conducted, but was much slower than that predicted by calculations reported in the literature for discrete stages. (auth)

**18200** BARIUM FLUOZIRCONATE PRECIPITATION. IMPROVED PROCESS FOR URANIUM–ZIRCONIUM ALLOY FUELS. B. E. Paige, B. J. Newby, and K. L. Rohde (Phillips Petroleum Co., Idaho Falls, Idaho). Ind. Eng. Chem., Process Design Develop., 2: 112-16(Apr. 1963).

The simultaneous removal of zirconium and fluoride as barium fluozirconate from hydrofluoric acid solutions created during the reprocessing of zirconium alloyed reactor fuel is an attractive means of decreasing waste volumes and increasing extraction column capacities. Conditions for precipitation, the degree of zirconium removal, uranium losses, and corrosion data for this process are reported. Methods for the precipitation of barium fluozirconate at 90 and 23°C are compared. Fission-product distribution data for two methods at 90°C were measured and relative distribution of heat from radioactive decay in process streams was calculated. (auth)

**18201** URANIUM RECOVERY FROM UNIRRADIATED REACTOR FUEL ELEMENTS. VOLATILE SEPARATION IN INERT FLUIDIZED BEDS. J. J. Reilly, W. H. Regan, E. Wirsing, and L. P. Hatch (Brookhaven National Lab., Upton, N. Y.). Ind. Eng. Chem., Process Design Develop., 2: 127-33(Apr. 1963).

Studies were conducted on the recovery of uranium by fluoride volatilization from four reactor fuel materials: Zircaloy-clad Zr–U alloy, uranium carbide, uranium metal, and uranium oxide. For Zr-type fuel, an initial treatment with anhydrous HCl removed Zr as volatile $ZrCl_4$. Similarly uranium carbide was oxidized to remove carbon as $CO_2$. Uranium metal and uranium oxide were fluorinated directly. All the reactions were carried out using a single reactor and in the presence of a fluidized Alundum bed. The use of such a bed, because of its heat transfer properties, permitted the highly exothermic reactions involved to be carried out under controlled conditions. (auth)

**18202** ON ION CHELATING RESINS WITH COMPLEXING ANCHOR GROUP. IV. THE BINDING RATIOS OF RARE EARTH IONS ON IDE-CHELATING RESIN. R. Hering (Karl-Marx-Universität, Leipzig). J. Inorg. Nucl. Chem., 24: 1399-1404(Dec. 1962). (In German)

The results of the investigation, connected with the present knowledge of the structures of the rare earth complexon chelates led to the conclusion that, contrary to the best results in the separation of bivalent metal ions already known, the separation of neighboring rare earth ions on iminodiacetic acid chelating resin by diluted mineral acid appears to be impossible. (auth)

**18203** SYNERGISM IN THE SOLVENT EXTRACTION OF DI, TRI AND TETRAVALENT METAL IONS. IV. ABSORPTION SPECTRAL STUDIES OF THE SYNERGISTIC COMPLEXES. T. V. Healy and J. R. Ferraro (Argonne National Lab., Ill.). J. Inorg. Nucl. Chem., 24: 1449-61 (Dec. 1962). (TID-15264). (In English)

Stable solid complexes were isolated and are shown to have the same formulas as metal complexes previously synergistically extracted from aqueous solution by an organic phase containing thenoyl trifluoroacetone (HTTA) and neutral organophosphorus compounds. The formulas were confirmed by uv and visible absorption spectrophotometric measurements of dilute solutions of uranyl, thorium, and neodymium complexes. (P.C.H.)

**18204** DEPOSITION OF VARIOUS RADIOACTIVE ELEMENTS ON THE SURFACE OF THE PLATINUM

ANODE. I. Mádi (Kossuth Univ., Debrecen, Hungary). J. Inorg. Nucl. Chem., 24: 1501-15(Dec. 1962).

The anodic deposition of $Tl^{204}$, $Ce^{144}$, $Y^{90}$, $Yb^{175}$, $Pr^{143}$, $Pm^{147}$, and $Ho^{166}$ was investigated as a function of time, with special consideration of $Tl^{204}$ and $Ce^{144}$. These studies show that when these atoms are anodically deposited, a plot of the equilibrium distribution coefficient as a function of the applied voltage passes through a maximum. The number of active centers on the surface of the platinum anode was determined for the anodic deposition of $Tl^{204}$ and $Ce^{144}$ by the isotherm method. A plot of the number of active centers as a function of the applied voltage also gave a curve with a maximum. The effect of hydrogen ion concentration was also investigated and a linear relation between the pH and the logarithm of the number of active centers found. Investigation of the deposition of $Tl^{204}$ on platinum from a solution containing hydrogen peroxide shows that the chemisorbed oxide layer, which develops on the platinum anode, plays an important role in the anodic deposition. (auth)

**18205** ANOMALOUS SOLVENT EFFECTS IN THE EXTRACTION OF Co(II) FROM AQUEOUS CHLORIDE SOLUTIONS BY LONG CHAIN ALKYL AMINES. M. L. Good and F. F. Holland, Jr. (Louisiana State Univ., New Orleans). J. Inorg. Nucl. Chem., 24: 1683-5(Dec. 1962).

A study was made on the extraction efficiency obtained with trialkyl amine systems dissolved in bromochloroalkane solvents for cobalt(II). The results show that the percent extraction of cobalt(II) increases with the age of the amine solution in bromochloroalkane. Experiments with the quaternary salts of the amines were conducted which indicate that the increase with age is due to the displacement of the bromine in the solvent and the formation of a quaternary salt of the amines. (D.L.C.)

**18206** ACID LEACHING OF URANIUM AND THORIUM CARBIDES. P. L. Pauson, J. McLean, and W. J. Clelland (Royal Coll. of Science and Tech., Glasgow). Nature, 197: 1200(Mar. 23, 1963).

Experiments with the formation of organic compounds in reaction of 6 N $HNO_3$ with uranium carbides are described. After removal of U with TBP in benzene, the aqueous raffinate was evaporated and the residue esterified with diazomethane. The presence of mellitic and oxalic acids is attributed to formation of graphitic carbon which is then oxidized. Up to 95% (in the case of $U_2C_3$) of the carbon originally present could be accounted for as $CO_2$ evolved, mellitic acid, and other unidentified acids. (T.R.H.)

**18207** THE EXTRACTION OF URANIUM(VI) FROM SULPHURIC AND NITRIC ACID SOLUTION BY DI-(2-ETHYLHEXYL)-PHOSPHORIC ACID. Taichi Sato (Government Chemical Industrial Research Inst., Tokyo). Naturwissenschaften, 50: 19(1963). (In English)

The partition of $U^{6+}$ between $H_2SO_4$ or $HNO_3$ solutions and the solutions of di-(2-ethylhexyl) phosphoric acid (DEHPA) in kerosene was investigated by varying the acid concentrations, solvent and aqueous uranium, and temperature. The partition coefficient for $U^{6+}$ extraction from $H_2SO_4$ solutions of varying concentrations decreases with increasing aqueous acidity. With increased organic phase U concentration, the polymeric U-DEHPA complex is formed. For extraction from $HNO_3$ solutions, the partition coefficient decreases with aqueous acidity below 3 M $HNO_3$, but above this value the shape of the extraction isotherm is similar to that obtained with TBP. The mechanisms involved are given. (J.S.R.)

**18208** THE MECHANISM OF URANIUM(VI) EXTRACTION FROM SULPHURIC ACID SOLUTIONS BY TRI-N-OCTYLAMINE. Taichi Sato (Government Chemical Industrial Research Inst., Tokyo). Naturwissenschaften, 50: 42(1963). (In English)

The partition of $U^{6+}$ between $H_2SO_4$ solutions and solutions of tri-n-octylamine (TOA) in benzene was investigated by varying the concentrations of $H_2SO_4$, solvent and aqueous uranium, and temperature. The results show that the partition coefficient first rises steeply with the acidity, passes through a maximum, and then falls rapidly. The amine uranyl sulfate complex is formed in the presence of U, as indicated by both partition coefficient variations and infrared spectral studies. The mechanisms proposed are $UO_2SO_4(a) + 2\ (R_3NH)_2SO_4(o) \rightleftharpoons (R_3NH)_4UO_2(SO_4)_3(o)$ at low acidities and $UO_2SO_4(a) + 4\ (R_3NH)HSO_4(o) \rightleftharpoons (R_3NH)_4UO_2(SO_4)_3(o) + 2\ H_2SO_4(a)$, where (a) and (o) indicate aqueous and organic phases and R, $C_8H_{17}$. (J.S.R.)

**18209** INORGANIC EXTRACTION STUDIES ON THE SYSTEM ALKYLAMINE-NITRIC ACID. AMBERLITE LA-1 AND TRI-ISO-OCTYLAMINE. Tomitaro Ishimori, Kan Kimura, Eiko Nakamura, Kuniko Tsukuechi, and Tomiko Osakabe (Japan Atomic Energy Research Inst., Tokyo). Nippon Genshiryoku Gakkaishi, 5: 89-96(Feb. 1963). (In English)

The solvent extraction behavior of about sixty chemical elements was extensively surveyed in the alkylamine-nitric acid system, clarifying radiochemically the acid dependence of distribution ratios. The organic phases used were 10% (V/V) Amberlite LA-1 and 5% (V/V) tri-iso-octylamine xylene solution. The highly extractable chemical species were not so many in number through two extraction systems. In most cases the acid dependence curves of a given element were not only similar to each other between the two systems, but also resembled that in 100% TBP-$HNO_3$ system. The exceptional high $K_d$ value of technetium at 1 N $HNO_3$ suggested an application to separating $Tc^{99m}$ from neutron-irradiated ammonium molybdate. (auth)

**18210** NEW MEASURES OF SEPARATION EFFICIENCY IN A SOLVENT EXTRACTION PROCESS. Takehiko Ishihara and Takeshi Tsujino (Japan Atomic Energy Research Inst., Tokyo). Nippon Genshiryoku Gakkaishi, 5: 104-10(Feb. 1963). (In English)

Separation and decontamination factors for three steps of an extraction process, i.e., extraction, scrubbing, and stripping, as well as an overall decontamination factor for the extraction process as a whole are defined to show the separation efficiency in the process. The equations are derived between these factors and experimental values such as distribution ratios, scrubbing percents, and stripping percents. The equations are applied to the separation of fission products/uranium with tributyl phosphate (TBP) and seven alkyl amines irradiated to the extent of $10^8$ r, in order to follow the radiation effect on separation and decontamination factors. Decontamination factors decrease with increasing dosage in the TBP system, whereas they increase in most amine systems. N-cyclohexyl dilauryl amine and TBP are the best for the decontamination among unirradiated extractants. Amberlite LA-2 is the best among the irradiated. In most cases a scrubbing step is more important than an extraction step as far as the decontamination of fission products/uranium is concerned. (auth)

**18211** THE REMOVAL OF $^{60}Co$ IN AQUEOUS SOLUTION WITH COBALT METAL. Yuichiro Kamemoto and Shigeru Yamagishi (Japan Atomic Energy Research Inst., Tokyo). Nippon Genshiryoku Gakkaishi, 5: 141-3(Feb. 1963). (In Japanese)

It is well known that an exchange reaction between metal

and its ion in solution occurs at the surface of the metal. Using this exchange reaction technique, the removal of $Co^{60}$ from an aqueous solution with cobalt metal was studied. When 2 ml of 0.1N or 1N $NaNO_3$ solution containing trace amounts of $Co^{60}$ was shaken vigorously with 50 mg of cobalt metal (powder) for about 30 min, up to 95 to 100% of $Co^{60}$ was removed from the solution. The higher normality of HCl or $HNO_3$ solution containing the tracer of $Co^{60}$ was used, the lower rate of removal of $Co^{60}$ from this solution was obtained. This experiment result may be due to the following reason, i.e., a part of cobalt metal was dissolved in acid solution and it resulted in the increase of the content of cobalt ion in this solution. It was found that up to 95 to 100% of $Co^{60}$ was rapidly removed from 0.5N $NaNO_3$ solution containing 10 μg of nickel per ml using this exchange reaction techniques with cobalt metal. In this experiment, however, about 40% of nickel was also deposited on cobalt metal and the separation of $Co^{60}$ from nickel ion was not satisfactory. (auth)

**18212** LANTHANIDES, THEIR SEPARATION AND UTILIZATION. Vaeino Veijola. Suomen Kemistilehti, 35A: 165-70(1962). (In Finnish)

A general and historical review of the lanthanide series of elements is presented, including their separation by various column and extraction techniques. Industrial uses of the rare earths and the economic problems involved in their separation are reviewed. Among the more effective and still not too expensive chelating agents which may be used for the separation, glycine sulfate (NTA) and ethylenediamine tetraacetic acid (EDTA) are prominently mentioned. A plant is being constructed for the separation and purification of the rare-earth elements; this plant is scheduled to go on stream early in 1963. (TTT)

**18213** SOLVENT EXTRACTION OF NIOBIUM AND TANTALUM FROM HYDROXY ACID SOLUTIONS BY 8-OXYQUINOLINATE COMPLEX. I. P. Alimarin, G. N. Bilimovich, and Hsien-Hang Tsui. Zh. Neorgan. Khim., 7: 2725-30(Dec. 1962). (In Russian)

Separation of niobium 8-hydroxyquinolinate from aqueous tartaric, acetic, oxalic, and trioxyglutaric acid solutions by various solvents was investigated. It was found that niobium 8-hydroxyquinolinate is extracted more efficiently by organic solvents; moreover, the extraction curve has two peaks with the minimum at pH ~ 7. It was also found that niobium 8-hydroxyquinolinate can be extracted by polar and non-polar solvents. The optimum conditions were found for niobium 8-hydroxyquinolinate extraction and separation from tantalum. (R.V.J.)

**18214** METHOD OF DISSOLVING REFRACTORY ALLOYS. D. M. Helton and J. K. Savolainen (to U. S. Atomic Energy Commission). U. S. Patent 3,086,926. Apr. 23, 1963.

This patent relates to the dissolution of alloys of uranium with zirconium, thorium, molybdenum, or niobium. The alloy is contacted with an anhydrous solution of mercuric chloride in a low-molecular-weight monohydric alcohol to produce a mercury-containing alcohol slurry. The slurry is then converted to an aqueous system by adding water and driving off the alcohol. The resulting aqueous slurry is electrolyzed in the presence of a mercury cathode to remove the mercury and produce a uranium-bearing aqueous solution. This process is useful for dissolving irradiated nuclear reactor fuels for radiochemical reprocessing by solvent extraction. In addition, zirconium-alloy cladding is selectively removed from uranium dioxide fuel compacts by this means. (AEC)

# ENGINEERING AND EQUIPMENT

## General and Miscellaneous

*Refer also to abstract 19578.*

**18215** (ASD-TDR-63-244) A NUCLEAR-PHOTON ENERGY CONVERSION STUDY. H. V. Watts, M. D. Oestreich, and R. J. Robinson (Illinois Inst. of Tech., Chicago. Armour Research Foundation). Feb. 1963. Contract AF33(657)-8527. 61p.

A double energy conversion technique is studied for aerospace use as a radioisotope-powered, 10-watt electrical output power source. In this technique, beta particles from a radioisotope are absorbed by a luminescent material which emits a multiplicity of low energy photons. These photons are then converted to electrical energy by a photovoltaic device. The three components (radioisotope, phosphor, and photovoltaic cell) are discussed individually and then in combination in various geometries of source-phosphor and phosphor-photovoltaic converter. Nuclear radiation effects on the phosphor and photovoltaic materials restrict the choice of the radioisotope to a low-energy beta emitter; and temperature effects limit the number of "unit power cells" that may be stacked in one bundle. These effects are more pronounced in silicon photovoltaic converters than in ZnCdS:Cu type phosphors. A ten-watt source (Pm-147, ZnCdS:Cu, and silicon photovoltaic cells) would have an overall energy conversion efficiency of about 0.2 percent and a power per weight ratio of 4 mw/lb. It is estimated that the power per weight could be increased by a factor of ten to forty if certain "ideal" materials were available. The rapid decrease in photovoltage and energy conversion efficiency of silicon cells at low illumination intensities causes an appreciable loss in the overall efficiency of such power source. (auth)

**18216** (CEAL-TM-102) D-C POWER SUPPLIES FOR EXPERIMENTAL MAGNETS. L. A. Young (Cambridge Electron Accelerator, Mass.). Sept. 28, 1962. 34p.

Seventeen d-c power supplies with power ratings of 75 to 500 kw and current ratings of 150 to 1000 amps are described. Control characteristics (output voltage vs. input current) are given, and some features of magnet current regulators built for use with the power supplies are described. Schematics of the devices and of the power supply arrangement are included along with comments on safety devices and operational precautions. (D.C.W.)

**18217** (DEG-Report-234) CREEP STABILITY OF TUBES UNDER EXTERNAL PRESSURE. J. P. Ellington (United Kingdom Atomic Energy Authority. Development and Engineering Group, Risley, Lancs, England). Aug. 29, 1960. 11p.

A study is made of the stability, in a classical sense, of a truly circular tube subjected to external pressure under creep conditions. After the pressure has been applied for a certain time, the tube is imagined to receive a small impulsive disturbance and the magnitudes of the resulting disturbances are examined, the stability condition being that the displacement should not increase with time. It is shown that after some critical time of pressure application loss of stability occurs, and an expression for this critical time is found for a material possessing strain-hardening creep characteristics. (auth)

**18218** (IDO-16844) CHEMPUMP PERFORMANCE FOR HIGH TEMPERATURE ORGANIC SERVICE. R. G. Young (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). Mar. 15, 1963. Contract AT(10-1)-205. 28p.

Performance testing of the two canned-type pumps being used for high temperature service in the EOCR was completed. Testing showed a tendency for gases to build up in the pump rotor cavity and heat exchanger, resulting in pump overheating. This problem is correctable by redesigning the heat exchanger to provide proper venting. An external self-venting heat exchanger was designed and installed on the two-stage pump. Testing showed satisfactory performance of the modified pump. A summary of operation for the test pumps is presented. (H.G.G.)

**18219** (NAA-SR-Memo-8035) LEAKAGE CHARACTERISTICS OF MULTI-CONDUCTOR CABLES AND CONDUIT SEALS. C. Nelson and S. Becker (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Dec. 12, 1962. Contract [AT(11-1)-Gen-8]. 15p.

Pipe threads in conduit seal-offs can be made air tight by use of a two-part thiokol-epoxy sealant such as "Sika." This material bonds to metal but does not harden; thus, threaded parts can be separated. Gas seals in conduit seal-offs can be made by use of "Chico, Type A" sealant. This material is hard and can withstand high pressure differentials. However, there is a detectable leakage through "Chico, Type A." "Sika" can be used to make a suitable gas-tight seal. However, this material is flexible and will not support long cable lengths. A dual pour method is suggested of first casting "Chico" around the connectors to obtain strength in the seal and then using either "Sika" or "Micro-Preg" to produce a tight seal. Leakage through the cable, between strands of conductor, can be reduced by either soldering the ends or dipping the ends in conductive epoxy paint. (auth)

**18220** (NAA-SR-Memo-8239) CARBON REMOVAL FROM SODIUM BY FILTRATION. S. K. Lee (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Feb. 22, 1963. Contract [AT(11-1)-Gen-8]. 10p.

"Micro Metallic" filters with pore sizes of 5, 20, 35, and 65 microns were tested for their effectiveness in removing carbon from sodium. Carbon was added to sodium, held at 1200°F for solution of carbon, and subsequently filtered at either 1200 or 300°F. Vacuum filtering was necessary to effect the flow of sodium through the filters. The carbon content of sodium filtered at 1200°F was below the reported solubility of carbon in sodium containing 40ppm oxygen at the solution temperature. The carbon content of sodium filtered at 300°F was approximately the same as the reported solubility of carbon in sodium containing 40ppm oxygen at the precipitation temperature. The 5, 20, and 35 micron filters appeared to be equivalent in ability to remove carbon at 300°F. The 65 micron filter was relatively ineffective. Although the tests were not sufficiently controlled to establish quantitative evaluation of filtering for carbon removal, the results indicate the feasibility of the method. (auth)

**18221** (NAS-NRC-Pub-992) DESIGN FOR THE NUCLEAR AGE. Proceedings of a Conference Held as Part of the 1961 Fall Conferences of the Building Research Institute, Division of Engineering and Industrial Research.

(National Research Council. Building Research Inst.). 1962. 168p.

Although man has developed the high degree of science and technology to improve his environment that permits a life pattern of supreme livability with greatest safety and at lowest cost, he is again challenged by the threats of a nuclear age. Discussions are presented of means to combat the threats of a nuclear war with regards to protective structures both above and below ground for radiation and blast protection. Protection against a nuclear attack can be greatly improved if designers provide structures with appropriate protection characteristics. Effects on buildings of blast waves, thermal and initial nuclear radiation, and fallout under various conditions are described. Structural design for the nuclear age requires consideration of these parameters. Protection against residual radiation is increased by the addition of small amounts of massive structural material at selected locations within a building. Experimental work done to identify the design requirements for mechanical equipment necessary to provide building services in protective structures such as ventilation, heating, air cleaning, humidity control, power supply, and lighting is summarized. Studies made of shelter in schools, multistory office buildings and apartment buildings to determine the extent and cost of modification necessary to protect the building population from fallout radiation and blast are discussed. Requirements for blast shelter pose a much greater problem for the architect than those of fallout shelter. Research on fallout shelters and human behavior indicates that normal man has considerable ability to endure extreme demands on his physical and emotional resources. A full year project concerning the design of a nuclear city is discussed. It involves site selection, planning and designing a town of 9000 people to service a hypothetical electronic manufacturing facility. The town is located above-ground with the electronic plant and certain public use areas and the mass transportation system located underground and structured to survive against nuclear effects. The underground areas are planned for regular daily use, but can be converted into refuge living space for the entire population of the city when needed. The design solution is described in detail. (H.G.G.)

**18222** (UCRL-13042(Rev.)) STRESS-STRAIN DISTRIBUTION DURING TRANSIENT HEATING OF A TRANSVERSELY ANISOTROPIC MATERIAL. Bob H. Suzuki (Boeing Co., Seattle) and J. Frisch (California. Univ., Berkeley). June 30, 1962. Contract [W-7405-Eng-48]. 38p.

Four by six-inch transversely anisotropic plates of $\frac{1}{8}$ and $\frac{1}{4}$ inch thick pyrolytic graphite were subjected to transient heating in an oxyacetylene flame apparatus. At temperatures up to 1500°F, the temperature and thermal strain distributions were determined over the length and thickness of the plates. The thermal strains measured with an optical gage and the analytically determined strains calculated from the three-dimensional thermoelasticity equations for a two-dimensional temperature distribution were found to be in good agreement. The calculated stress distribution indicates that maximum compressive stresses of −1400 psi and −3000 psi were produced in the $\frac{1}{8}$-inch and $\frac{1}{4}$-inch pyrolytic graphite plates, respectively. (auth)

**18223** (UVA-198-62S) COUNTERCURRENT FLOW IN A SEMI-INFINITE GAS CENTRIFUGE. AXIALLY SYMMETRIC SOLUTION IN THE LIMIT OF HIGH ANGULAR SPEED. John Ging (Virginia. Univ., Charlottesville. Research Labs. for Engineering Sciences). Jan. 1962. Contract AT(40-1)-1779. 14p. (EP-4422-198-62S)

Equations for an approximate determination of the eigenmodes for the steady-state flow in a gas centrifuge operating at high angular speed and considering the effects of heat conduction are presented. The equations are written in cylindrical coordinates and the nonlinear parts of the inertial terms are neglected. It was convenient to use a system of coordinates that rotates with the angular velocity of the centriguge. The asymptotic solutions derived from these equations are compared with results obtained from the digital computer with a close agreement being noted. (H.G.G.)

**18224** (WAPD-T-1510) INTERPRETIVE REPORT OF PRESSURE VESSEL RESEARCH. Section 1.8—Significance of Calculated Stresses. B. F. Langer (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). May 1962. Contract AT-11-1-GEN-14. 20p.

The development of better methods for determining the stresses and distortions which occur in pressure vessels is reported. A suggested method of setting allowable stresses, designated as primary, secondary, and peak, is discussed. Modes of failure are examined along with application of limit analysis, required classes of stress limit, required ductility and realistic safety margins. (J.R.D.)

**18225** (WAPD-T-1516) INTERPRETIVE REPORT OF PRESSURE VESSEL RESEARCH. Section 1.2, Heads. B. F. Langer (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). June 1962. Contract AT(11-1)-Gen-14. 30p.

A review of the technology related to development of pressure vessel heads is presented. Sections are included on elastic analysis and stability. It is noted that methods are now available for calculation of elastic stresses in any practical shape of pressure vessel head without multiple openings. Further research is needed on stability of dished and conical heads. The present ASME code rules for head design appear to be good in the intermediate range of wall thickness-to-diameter ratio but become overly conservative for thicker-walled vessels. (J.R.D.)

**18226** (FTD-TT-62-1724) OPTIMUM GEOMETRICAL RATIOS IN INDUCTION PUMPS FOR LIQUID METALS. N. M. Okhremenko. Translated from Elektrichestvo, No. 9, 10-16(1961). 20p.

Selection of optimum geometric ratios in induction pumps is discussed from the standpoint of maximum efficiency conditions and minimum weight of active materials. It is shown that optimization of these parameters requires the selection of a ratio of channel width to height in the interval from 20 to 40. (J.R.D.)

**18227** PUMPS IN NUCLEAR POWER PLANTS. Manfred Laib (Schanzlin and Becker A. G., Palatinate, Ger.). At. Strom, 9: 1-4(Jan. 1963). (In German)

The pumps used in the conventional part of the power plant are briefly described as an introduction to a consideration of the pumps used in the primary circuit. The construction details, materials used, and testing procedures are discussed. (J.S.R.)

**18228** RIGHT-ANGLE CLOSED CIRCUIT TV SYSTEM FOR HOT CELL OPERATION. Henry M. Bailey (Cohu Electronics, Inc., San Diego, Calif.). Atomics, 16: No. 2, 54-6(Mar.-Apr. 1963).

A closed-circuit TV system for observing remote-control operations in a windowless cell is described. An arrangement of two (or more) cameras moving on right-angle tracks was developed and tested. High-definition cameras with ZOOM lenses and pan-tilt mounts were used. The two

cameras give the operator a three-dimensional fix on any selected point within the cell. A "joystick" TV control was developed from an existing manipulator pistol-grip control unit. The tracks are made of nearly pure aluminum to reduce activation from neutron radiation. (M.C.G.)

**18229** THE X-FLOW POLYBLOC SYSTEM OF CONSTRUCTION FOR GRAPHITE. A. Hilliard. Brit. Chem. Eng., 8: 234-7(Apr. 1963).

A further development of the Polybloc system of construction for anisotropic materials in general, and graphite in particular is described. This is called the X-flow system and is applicable to heat exchange equipment. Both sets of passages are drilled in X-form through solid cylindrical blocks, terminating in different sectors on the same block faces. The blocks are assembled in a column and held under compression by external spring-loaded tie rods. Both fluids circulate via abutting block faces and contact only graphite and PTFE ring gaskets at joints. Advantages claimed for the system are that it is robust, inert, compact, avoids tensile and flexural stresses, and also exploits the end effect for turbulent flow at slow circulation rates to produce high heat transfer coefficients and an important antifouling effect at low pressure drop. (auth)

**18230** DESIGN OF VESSELS FOR COMMERCIAL SERVICE AT EXTREME PRESSURES. J. L. Skinner (Continental Oil Co., Ponca City, Okla.), R. D. Daniels, and C. M. Sliepcevich. Brit. Chem. Eng., 8: 245-50(Apr. 1963).

Recent developments of high strength materials, particularly alloy steels and carbides, with yield strengths in excess of 200,000 psi have pushed the practical upper limit for pressure vessels in commercial service to 250,000 psi and higher through proper utilization of the properties of the construction materials and fabrication techniques. No limitations as to the size of the vessel are imposed except in so far as the desired material properties are limited by size. The relative merits of using simple, compound, or autofrettaged design and/or a combination of these is demonstrated by specific examples. Particular emphasis is given to the peculiar limitations of material properties and fabrication procedures in selecting the optimum design. (auth)

**18231** ON A THERMAL FLOW-RATE METER FOR HANDLING $UF_6$ GAS OR OTHER SPECIAL GASES. Yoichi Takashima and Yoshihiko Nara. Bull. Tokyo Inst. Technol., Spec. No. 49, 181-93(1962). (In English)

A theoretical analysis on the thermal behavior was carried out with a simple model of thermal flowmeter. The calculation results of $\Delta t$ to Pe have shown a fairly good agreement with the test results. The thermal flow meter will be available directly for $UF_6$ gas or other gases without a calibration by themselves if the characteristic curve, that is, the relation of $\Delta t/k_g$ to Pe has been obtained by the air test. (auth)

**18232** A TRANSISTORIZED OPERATIONAL AMPLIFIER FOR DATA PROCESSING SYSTEMS IN NUCLEAR PLANTS. S. Colussi, F. Fioroni, and R. Marconero (CNEN, Rome). Comit. Nazl. Energia Nucl., Notiziario, 9: 57-65(Jan. 1963). (In Italian)

The operation of a nuclear plant requires checking and analyzing a large number of non-homogeneous variables, measured by primary transducers which are often nonlinear. A transistorized operational amplifier for data processing systems in nuclear plants is described. (auth)

**18233** PERFORMANCE OF A COCURRENT DISTILLATION CONTACTING DEVICE. G. C. Angelino, B. Brigoli, and M. Silvestri (Centro Informazioni Studi Esperienze, Milan). Energia Nucl. (Milan), 10: 85-97(Feb. 1963). (In English)

The application of cocurrent two phase flow to mass transfer in steam-water system was investigated. A suitable contacting device which allows operation at vapor velocities up to about 20 m/s at atmospheric pressure is described. The hydrodynamic and isotopic behavior of this type of contacting device was tested and data are given at temperatures ranging from 89 to 110°C. (auth)

**18234** BUILDING HEMISPHERES OF HIGH EXPLOSIVES FROM CAST BLOCKS 500 POUNDS TO 100 TONS. W. J. Ditto and J. Holdsworth. Eng. J., 45: No. 7, 29-32 (July 1962).

Investigation of shock and blast phenomena in free air raised a requirement for hemispherical explosive charges to be burst at ground level. Charges of approximately the desired shape were built from cast blocks of TNT of approximately 33 lb and dimensions 12 in. × 12 in. × 4 in. Because TNT shrinks as it hardens, and because rapid cooling seems to produce the most desirable crystalline structure, it was decided to cool the molds with water from the bottom region and up the sides and maintain a hot header of liquid from the top down into the center to fill in for shrinkage. The molds were not pre-heated and TNT pouring temperatures of around 95°C were found most suitable. The molds were cooled with water for about 45 min and then in air for 4 or 5 hr with steam probes maintaining liquid at the top. After this period the probes were removed and the mold left overnight before removal of the blocks. Booster charges were cast from a mixture of crystalline Tetryl and TNT in proportions of 70 : 30. (M.C.G.)

**18235** AIR SAMPLE LABELING. A. C. Weyerts (E. I. du Pont de Nemours and Co., Aiken, S. C.). Health Phys., 9: 236(Feb. 1963). (TID-16887)

Instead of manual marking of filter discs to indicate the location of air samples, the use of the visible deposits is recommended. Commerically available letters or numerals cemented to filter holders may be used. (D.L.C.)

**18236** THE BK24 IGNITRON AS A HIGH CURRENT SWITCH. L. W. Kerr, J. W. McConkey, and J. W. G. Wilson (Queen's Univ., Belfast). J. Electron. Control (1), 14: 223-30(Feb. 1963).

The performance of the BK24 ignitron as a switch in high current pulsed applications is studied, the closed circuit impedance of the valve for fast (less than 100 $\mu$sec) and slow (msec), pulses being investigated. The valve resistance is found to fall from an initial valve of 23 m$\Omega$ to a minimum of a few milliohms some hundred microseconds after ignition. The rating of the valve for fast pulse operation is discussed. (auth)

**18237** AN APPARATUS FOR THE GENERATION OF SOFT X RAYS. Richard J. Kuhn. J. Forensic Sci., 6: 225-33(Apr. 1961).

The construction of an apparatus for the generation of soft x-rays is described. Radiographs of watermarks in paper, made with the apparatus described, are shown, and its application in the document laboratory is discussed. The apparatus was built using a WX 12 tube as the x-ray tube, powered by a supply constructed from television components easily obtainable at a cost of less than $100. The circuit of the power supply, which is illustrated, delivers 40 kv. An a-c voltage is generated by 6L6 tube which is amplified by two 6BG6 tubes and applied to a high voltage transformer. 1B3 tubes are used for a voltage quadrupler circuit. In order to get sufficient drive for the multiplier

circuit to work and to overcome the loading effects, a high power 6L6 tube is used as an oscillator. In order to keep the load on the transformer at a minimum, the filaments of all the 1B3 tubes are heated by batteries. The apparatus operates directly from 110-v mains, and power consumption is about 250 w. (TCO)

**18238** COMPUTING OF THE FEED WATER PREHEATING TEMPERATURE IN THE DOUBLE CIRCUIT SCHEMES OF ATOMIC ELECTRIC POWER STATIONS. D. Grecov and S. Haiduc. Rev. Electrotech. Energet., Acad. Rep. Populaire Roumaine., Ser. B, 7: 273-82(1962). (In Russian)

The computing formulas of the pre-heating temperature in double circuit schemes are shown and the results of the computation variants in the hypothesis that the reactor thermal power is $Q_t = 400$ M are given. The application of the formulas recommended allows a considerable volume of computations to be avoided, pointing concomitantly to the influence of the various factors of the thermal scheme on the parameter under study. (auth)

**18239** SIMPLE HIGH-VOLTAGE PLASMA SWITCHES. N. O. O. Eikel and H. M. Skarsgard (Univ. of Saskatchewan, Saskatoon, Can.). Rev. Sci. Instr., 34: 299-300(Mar. 1963).

Two plasma switches, one multiple-gap and the other single-gap, are designed which have self-cleaning properties due to the use of organic insulators. The results of tests of the switches are described; the inductance was measured to be $0.015 \pm 0.003\ \mu H$. The two switches can be used interchangeably to give trouble-free switching over a wide range of peak currents. (D.L.C.)

**18240** NOVEL TECHNIQUE FOR FORMING A NARROW SLIT IN A METAL PLATE. Dwight L. Allensworth (Sandia Corp., Albuquerque, N. Mex.). Rev. Sci. Instr., 34: 302(Mar. 1963). (TID-16891; SCDC-2882)

A simple technique was developed for cutting a uniform collimating slit of 0.001 to 0.005 in. width in a single metal plate. The technique involves the steps of machining a V groove in one surface of the plate so that the groove bottom grazes the opposite surface without cutting through, boring holes where the slit ends are to be located, cutting the slit with a wire of high tensile strength (e.g., tungsten) of the same diameter as the slit width, and honing the slit to remove burrs. (D.L.C.)

**18241** TRANSISTORIZED ION SOURCE POWER SUPPLY. Frank M. Propst, Harry Tomaschke, and Dominic Skaperdas (Univ. of Illinois, Urbana). Rev. Sci. Instr., 34: 312-13(Mar. 1963).

A d-c power supply is designed for regulating the trap current in an electron bombardment ion source. The power supply is based on an ion gage supply and incorporates a chopper amplifier for d-c isolation from the filament current supply. The operation and performance of the power supply are described. (D.L.C.)

**18242** EFFECT OF ANGULAR MOMENTUM ON SHIP COLLISIONS, WITH SPECIAL REFERENCE TO THE SAFETY OF NUCLEAR-POWERED SHIPS. G. Woisin. Schiff Hafen, 14: 577-81(July 1962). (In German)

The effect of angular momentum on a ship collision was analyzed. The parameters studied in this analysis were the magnitude of the destructive energy, frequency and severity of collisions at various impact points, effect of size variation of the colliding ships, effect of the penetration depth, and alterability of the collision acceleration. (J.S.R.)

**18243** ON THE PROSPECT OF EMPLOYING MAGNETOHYDRODYNAMIC GENERATORS FOR SHIP PROPULSION. G. A. Matveev and P. D. Ivanov. Sudostroenie, No. 2, 32-6(1962).

The basic features of magnetohydrodynamic (MHD) power generating units are discussed with a view to their utilization for ship propulsion. Theoretical principles of a magnetohydrodynamic generator are displayed. It is pointed out that the MHD method of power generation makes it possible to use fuel gas at much higher temperatures than in gas turbines, and thus to reduce dimensions with a simultaneous increase of efficiency. It is estimated that a MHD generator of 426000 kW may be 25% more efficient than the most efficient conventional power plant. (P.C.H.)

**18244** DESIGN AND INSPECTION— HOW THEY INFLUENCE MANUFACTURING EFFICIENCY. E. S. Roth (Sandia Corp., Albuquerque, N. Mex.). Tool. Mfg. Engr., 50: No. 2, 69-72(Feb. 1963). (TID-16724; SCDC-2759)

Ground rules for the design drawings are proposed for improving the manufacturing efficiency and reducing scrap losses. These ground rules cover design layout (simplicity and accuracy), positional tolerancing (datum definition), design review, and inspection (gage tolerances). (D.L.C.)

**18245** HOT CANYON CRANE (Engineering Materials). (Du Pont de Nemours (E. I.) & Co. Savannah River Plant, Aiken, S. C.). (CAPE-930)

Hot-canyon cranes are used for installing, removing, and maintaining canyon process equipment. The crane design (221-F & H) presented is remotely controlled and has a 50-ton capacity. There is a specially shielded cab which houses the operator and controls. The cab has filtered, temperature-controlled air. There is also a 10-ton auxiliary hoist and two twin-drum hoist units. The trolley movement across the top of the main girders is 20 ft and is achieved by use of the main $7\frac{1}{2}$ hp motor or a $\frac{1}{6}$ hp gear motor through a 10 v gear assembly. The $7\frac{1}{2}$ hp motor is controlled by a five-step regulator that moves the trolley from a slow rate to 75 ft/min in either direction. The $\frac{1}{6}$ hp gear motor moves the trolley at the rate of 1.4 ft/min in either direction. There are 15 CAPE units in this package consisting of 14 drawings and a 2-sheet description. (F.E.S.)

**18246** PROCEEDINGS OF THE SYMPOSIUM ON PRESSURE VESSEL RESEARCH TOWARDS BETTER DESIGN, 18TH AND 19TH JANUARY, 1961. London, Institution of Mechanical Engineers, 1962. 265p.

Information from research associated with the design of pressure vessels was collated and discussed. Stress analyses, fatigue tests, and low-temperature brittleness were considered. A comparison of United States, European, and British Commonwealth codes for the construction of welded boilers and pressure vessels was presented. Pressure vessel design requirements in the near future were outlined. (C.E.S.)

**18247** DEMOUNTABLE DEVICE FOR PROCESSING, e.g. FILTERING, OF RADIOACTIVE FLUIDS. P. Dequenes (to Commissariat à l'Énergie Atomique). German Patent DAS 1,143,279. Feb. 7, 1963. Priority date Mar. 1, 1960.

The device described which is for processing, e.g., filtering, of radioactive fluids, consists of an outer container in a fixed position and an inner removable container, in which the processing takes place. Attached to the outer container is the inlet and the outlet pipe for the circulated fluid. The wall of the inner container is so constructed that it shields the whole device. Between the outer and the demountable inner container there is a sliding valve which automatically closes the inlet opening of the inner container when the latter is drawn out of the fixed outer container. (Gmelin Institute)

**18248** THERMAL RELAY DEVICE. R. O. Murdoch and F. A. Record (to U. S. Atomic Energy Commission). U. S. Patent 3,076,078. Jan. 29, 1963.

This invention relates to a fast-acting spring-loaded electrical switch which can break a 1500-volt circuit in one millisecond without arcing. In particular, a spring-loaded shorting bar is held in tension by a fusible wire. Passage of an electrical current pulse through the fusible wire breaks the fuse thereby releasing the shorting bar to open one and close another electrical circuit. (AEC)

**18249** LUBRICATING OIL PROCESS. Hillis O. Folkins (to Pure Oil Co.). U. S. Patent 3,083,151. Mar. 26, 1963. Filed Nov. 12, 1959.

A method is given for increasing the viscosity index of mineral lubricating oils by means of high-energy ionizing radiation. The method comprises irradiating the oil with $10^8$ to $10^9$ rads in an inert atmosphere at ambient temperature (<150°F) and subjecting the irradiated oil to controlled oxidation at 150 to 400°F. In this way, the viscosity index of an oil-base stock was raised from 100 to 142. (D.L.C.)

**18250** GREASES. George H. Clark and Edwin M. Dodds (to Esso Research and Engineering Co.). U. S. Patent 3,083,159. Mar. 26, 1963. Priority date Dec. 24, 1957, Great Britain.

A lubricating grease is described which is relatively resistant to radiation and hot carbon dioxide. The grease comprises a mineral oil of viscosity index less than 75 and containing more than 30 wt % aromatics, mixed with 5 to 40 wt % of carbon black. Preferably, 0.1 to 5 wt % of an oil-soluble ashless detergent is also added. (D.L.C.)

**18251** LOW PRESSURE PUMPING. Robert B. Goddard (to Lab. for Electronics, Inc.). U. S. Patent 3,084,257. Apr. 2, 1963. Filed Jan. 19, 1959.

A hydrogen pump of small size is designed which requires no external power source and which will operate for extended periods of time, such as in neutron generators in well logging systems. The pump comprises a container having a narrow inlet opening which is closed by a porous plug of glass wool, the container being partially filled with outgassed titanium powder. The sorption of hydrogen by the powder maintains dynamic pressures in the micron region for long periods of time. (D.L.C.)

**18252** METHOD OF DETERMINING CRITICAL LUBRICATION AREAS IN MACHINERY. Michael J. Furey (to Esso Research and Engineering Co.). U. S. Patent 3,084,260. Apr. 2, 1963. Filed Sept. 30, 1959.

A radioactive tracer method is given for locating critical areas of boundary lubrication and predicting wear in moving parts of machinery. The method comprises preparing a lubricating oil with a tracer, subjecting the moving parts to this oil, disassembling the machinery, and locating the critical areas by means of the radioactive film deposited thereon. A suitable tracer is a metal dialkyl dithiophosphate prepared from radioactive phosphorus. (D.L.C.)

**18253** ASSEMBLY OF PARALLEL PLATES. Edward F. Groh and David H. Lennox (to U. S. Atomic Energy Commission). U. S. Patent 3,086,935. Apr. 23, 1963.

This invention is concerned with a rigid assembly of parallel plates in which keyways are stamped out along the edges of the plates and a self-retaining key is inserted into aligned keyways. Spacers having similar keyways are included between adjacent plates. The entire assembly is locked into a rigid structure by fastening only the outermost plates to the ends of the keys. (AEC)

**18254** WELDING APPARATUS. Thomas B. Correy, Don E. DeWitt, and Ira V. Nelson (to U. S. Atomic Energy Commission). U. S. Patent 3,087,045. Apr. 23, 1963.

This patent covers an arrangement for replacing air in a welding chamber with an inert gas. This operation usually is time-consuming because of the tendency of the inert gas to mix with the air being removed from the welding chamber. The chamber is open at the bottom and has at its top a cover and a porous plate a little below the cover. The inert gas is admitted to the chamber through two screened openings in the cover. On passing through the porous plate, the gas acts as a piston extending across the chamber and moving downwardly to expel the air through the lower open end of the chamber, with a minimum of mixing with the air being expelled. (AEC)

**18255** HIGH VOLTAGE ELECTRODES. Joseph J. Murray (to U. S. Atomic Energy Commission). U. S. Patent 3,087,056. Apr. 23, 1963.

This patent relates to electrode structure for creating an intense direct current electric field which may have a field strength of the order of two to three times that heretofore obtained, with automatic suppression of arcing. The positive electrode is a conventional conductive material such as copper while the negative electrode is made from a special material having a resistivity greater than that of good conductors and less than that of good insulators. When an incipient arc occurs, the moderate resistivity of the negative electrode causes a momentary, localized decrease in the electric field intensity, thus suppressing the flow of electrons and avoiding arcing. Heated glass may be utilized for the negative electrode, since it provides the desired combination of resistivity, capacity, dielectric strength, mechanical strength, and thermal stability. (AEC)

**18256** AN ACTUATOR FOR A MANIPULATOR HANDLING RADIOACTIVE SUBSTANCES. A. F. Egorov. USSR Patent 146 165. Aug. 24, 1959.

An actuator was designed for a manipulator handling radioactive substances that uses flat four-bar links for turning the lever and a head in which the instrument is fixed. It is distinguished by the fact that, to reduce the overall transverse dimensions and increase the magnitude of the transmitted torque, the actuator consists of a tubular suspension, two concentrically placed cardan shafts with universal joints and intermediate shafts, and a single and a double link. The first is for turning the intermediate shaft, which is the lever, and the second for turning the head. (Byulleten izobreteniy, No. 7, 1962)

## Heat Transfer and Fluid Flow

**18257** (ANL-6625) LOCAL PARAMETERS IN COCURRENT MERCURY–NITROGEN FLOW. L. G. Neal (Argonne National Lab., Ill.). Jan. 1963. Contract W-31-109-eng-38. 74p.

Two instruments were developed which can be used to study the structure of two-phase flow: first, an electrical probe capable of measuring local values of the gas fraction, bubble frequency, and bubble-size spectra; second, an impact probe that can be used to measure the local liquid velocity. These instruments were used to measure local flow parameters in cocurrent mercury-nitrogen slug flow. These results are presented in tabular and graphical form. In addition, a photographic study was made to determine the shape of the individual slugs. The gas fraction and velocity profiles were analyzed by a modification of the variable-density model to include local slip. Results showed that the distribution of the phases is not important in determining the average phase velocity ratio, and that the average slip is a result of local buoyant forces. The photographic study showed that the structure of mercury-

nitrogen flow is much different from air-water flow. The slugs are asymmetric, with the gas rising up one wall and the mercury flowing down the opposite wall. This is a result of the high-surface energy of the mercury and, consequently, non-wetting of the wall. Because of the dissimilarity of flow structures, the correlations derived for air-water flow are not applicable to mercury-nitrogen flow. (auth)

**18258** (ANL-6667) A STUDY OF THE FLOW OF SATURATED FREON-11 THROUGH APERTURES AND SHORT TUBES. Hans K. Fauske and Tony C. Min (Argonne National Lab., Ill.). Jan. 1963. Contract W-31-109-eng-38. 19p.

An experimental study on the discharge rates of saturated and subcooled Freon-11 through apertures and short tubes is reported. The experiment covered a range of modified cavitation numbers between 0 and 500, length-to-diameter ratios of small-diameter tubes between 2 and 55, and sharp-edge apertures of nine different geometric configurations. It was found that below the modified cavitation number of 10, the fluid exhibits completely metastable single-phase flow. When the modified cavitation number exceeds 14, two-phase critical flow may exist. In the range of modified cavitation numbers between 10 and 14, unstable transitional flow occurs (alternating single- and two-phase flow). Euler numbers for the apertures of various configurations, including square, rectangular, and eye-shaped, were found to be in the same order of magnitude as those for circular shapes. The triangular orifices were found to possess higher Euler numbers and the W-shaped orifices lower than the circular ones. (auth)

**18259** (ANL-6674) REDUCTION OF VAPOR CARRYUNDER IN SIMULATED BOILING. P. L. Miller and C. P. Armstrong (Argonne National Lab., Ill.). Feb. 1963. Contract W-31-109-eng-38. 30p.

The effect on vapor carryunder in simulated boiling caused by insertion in the flow stream of several different geometric configurations and sizes of wire screens is described. The effect on vapor carryunder caused by screen location and mesh size is shown to be closely related to other system variables. The relationship among the most significant variables is shown in a series of graphs. Significant reduction of vapor carryunder is achieved under certain conditions. (auth)

**18260** (CVNA-128) A DIGITAL COMPUTER PROGRAM FOR CRITICAL FLOW DISCHARGE OF TWO-PHASE STEAM–WATER MIXTURES (CRITCO CODE). Amir N. Nahavandi and Michael P. Rashevsky (Westinghouse Electric Corp. Atomic Power Div., Pittsburgh). Feb. 1962. For Carolinas Virginia Nuclear Power Associates, Inc., Columbia, S. C. Contract AT(30-1)-2289. 67p.

The available theories for the prediction of critical flow discharge of two-phase mixtures are reviewed. The theories discussed are homogeneous model theory, annular flow theory and Fauske's theory. A FORTRAN program for an IBM-7090 digital computer for the application of these theories to the flashing flow of steam-water mixtures is developed. Critical mass flow velocities for a wide range of pressures and steam qualities are calculated and compared. A critical flow discharge chart, based on Fauske's theory for steam-water mixtures, is presented. A simple empirical formula for the prediction of critical flow discharge is proposed. This formula is useful in preparing computer programs involving two-phase critical flow. (auth)

**18261** (KAPL-M-EC-29) TIGER — TEMPERATURES FROM INTERNAL GENERATION RATES. David L. Briggs (Knolls Atomic Power Lab., Schenectady, N. Y.). Feb. 1, 1963. Contract W-31-109-eng-52. 81p.

TIGER is a digital computer program which will solve three-dimensional transient and steady-state heat transfer problems. The input consists of geometry, physical properties, boundary conditions, and internal heat generation rates. In addition to solving problems of heat conduction in a structure, TIGER can handle forced convection, free convection, and radiation or any combination of these at the surface of the structure. The output consists of complete nodal temperature distributions along with surface fluxes and surface heat transfer coefficients. An option is included in the program for determining the average temperature in any specified section of the structure. The first forward difference method is used in obtaining the solution. (auth)

**18262** (LA-2414) THE BOUNDING OF INSTABILITIES OF THE PIC DIFFERENCE EQUATIONS. Bart J. Daly (Los Alamos Scientific Lab., N. Mex.). Dec. 1962. Contract W-7405-eng-36. 63p.

A study was made of the effect of a nonlinearity on the stability properties of a simplified version of the PIC difference equations. An equilibrium amplitude of the fluctuations, resulting from the instability, was determined as a function of the parameters of the method. (auth)

**18263** (LAMS-2826) A METHOD FOR EULERIAN FLUID DYNAMICS. Marvin Rich (Los Alamos Scientific Lab., N. Mex.). Dec. 1962. Contract W-7405-eng-36. 97p.

A method is presented for obtaining numerical solutions of the Eulerian hydrodynamic equations for supersonic compressible flows. The procedure is an adaptation of the PIC method to the case of a continuous fluid. Some discussion is given concerning the limitations of the procedure; the conservation of mass, energy, and momentum; and the treatment of rigid obstacles and two-fluid interfaces. Examples of calculations for flows past a number of cylindrically symmetric objects are also presented. (auth)

**18264** (NAA-SR-6309) THE SNAP II POWER CONVERSION SYSTEM. TOPICAL REPORT NO. 17. MERCURY BOILING RESEARCH. R. G. Gido and Alfred Koestel (TAPCO. Div. of Thompson Ramo Wooldridge Inc., Cleveland). Oct. 1962. For Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif. Contract AT-11-1-GEN-8, Subcontract N843FS-101221. 184p. (TRW-ER-4833)

Activities in a boiling research program to provide data on heat transfer and pressure drop during vortex once-through forced convection boiling of Hg are reported. A test rig was built for test section configurations with swirl wire inserts; or in one case, a bare tube. Efforts were made during the testing of one swirl wire test section to obtain data on the independent effect of temperature difference, pressure level, flow rate, and quality level on heat transfer rate. The data are correlated according to forced convection vortex boiling theory. The data are meant to form part of the basis for improved design of SNAP II and similar boilers. (J.R.D.)

**18265** (NAA-SR-8171) CORRELATION OF LIQUID FRACTION IN TWO-PHASE FLOW WITH APPLICATION TO LIQUID METALS. C. J. Baroczy (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Apr. 15, 1963. Contract AT(11-1)-Gen-8. 41p.

A generalized correlation for the liquid fraction in two-phase flow is presented which is proposed for use with all fluids, including liquid metals. The correlation is based on isothermal, two-phase, two-component liquid fraction data for liquid $Hg-N_2$ and water-air. Liquid fraction is shown to be a function of the Martinelli flow modulus and liquid/gas density and viscosity ratios. Good correspondence is indicated between the liquid fraction predicted by this correlation and the Martinelli-Nelson correlation for steam, experimental data for steam, and experimental data for Santowax R. Prediction of liquid fraction by this method is shown for Na, K, Rb, and Hg. Application of the method to boiling Hg, for a range of temperatures and exit qualities, is demonstrated for SNAP systems. (auth)

**18266** (NAA-SR-Memo-6873 & Add. 1) FLOW STABILITY LOOP-FORCED CONVECTION HEAT TRANSFER WITH ORGANIC COOLANT. F. Bergonzoli and F. Halfen (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Nov. 15, 1961. Includes Addenum 1. Jan. 18, 1962. Contract [AT-11-1-GEN-8]. 14p.

In checking out the flow stability loop (Loop I) and the Fugue code with organic coolant, forced-convection heat transfer, experiments were made using isopropyl diphenyl. Operating conditions were as follows: coolant velocity 8 to 24 ft/sec; heat flux 10,000 to 100,000 Btu/hr $ft^2$; reynolds number 60,000 to 250,000; and system pressure 19 to 30 psia. Experimental heat transfer coefficients were in the range of 600 to 1800 Btu/hr $ft^2$ °F. The experimental heat transfer coefficients were compared to values predicted by the Dittus-Boelter equation as recommended for organic coolant. The agreement was found to be within ±10%. Additional experiments using the flow stability loop (Loop I) to check out the FUGUE code produced additional forced convection heat transfer data. These experiments were conducted using Santowax R (reactor grade) under the following conditions: coolant velocity 8 to 23 ft/sec; heat flux 17,000 to 75,000 Btu/hr $ft^2$; reynolds number 70,000 to 250,000; and system pressure 20 psia. Experimental heat transfer coefficients were in the range of 700 to 1800 Btu/hr $ft^2$ °F. These results are in good agreement with predictions of the Dittus-Boelter equation. (auth)

**18267** (NAA-SR-Memo-8018) APPLICATION OF THE CONSERVATION EQUATIONS OF MASS, MOMENTUM AND ENERGY TO AN UNSTEADY BULK BOILING CHANNEL. D. E. Schramm (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Dec. 5, 1962. Contract [AT(11-1)-Gen-8]. 13p.

Activities in a program to write the conservation laws of mass, momentum, and energy in an approximate form to handle a single, unsteady bulk boiling channel are discussed. Use is made of Bankoff's Variable Density, Single-fluid Flow Model in representing the fluid density and velocity in terms of the local void fraction and quality. Discussion of application of the thermal energy equation in outlining the form of an unsteady nuclear-hydraulic loop analysis is included. (J.R.D.)

**18268** (NAA-SR-Memo-8279) ADDITIONAL DATA FROM SODIUM POOL BOILING EXPERIMENTS. S. L. Shulman (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Mar. 6, 1963. Contract [AT(11-1)-Gen-8]. 22p.

The results of Na pool boiling experiments made in conjunction with certain tests of high-flux heaters are reported. Nucleate boiling heat transfer data from a 0.250 in. OD horizontal cylinder are reported. Pressures of 1, 3, and 8 psia were obtained with surface heat fluxes ranging from $3.6 \times 10^4$ to $8.4 \times 10^5$ Btu/hr-$ft^2$. Critical heat flux was obtained at pressures of 1.1 and 3 psia with surface heat fluxes of $6 \times 10^5$ and $8.3 \times 10^5$ Btu/hr-$ft^2$ respectively. (auth)

**18269** (NP-12666) HEAT TRANSFER ACROSS A LAMINAR LIQUID FILM IN A TURBULENT VAPOUR STREAM. HEAT TRANSFER ACROSS A TURBULENT LIQUID FILM IN A TURBULENT VAPOUR STREAM. RATE OF GROWTH OF A LIQUID FILM IN A LIQUID DROPLET/VAPOUR ISOTHERMAL FLOW. RÉSUMÉ OF "EXPERIMENTS ON THE EVAPORATION OF THIN LIQUID FILMS" AND ITS RELEVANCE TO "SPRAY EVAPORATION." Nuclear Research Memoranda, Q1-Q4. D. E. Hartley (London. Univ. Queen Mary Coll.). Jan. 1963. 16p.

Analysis of data on heat transfer across laminar liquid films in turbulent vapor streams leads to a correlation in terms of liquid film Reynolds number. The measured and estimated heat transfer rates are in good agreement only for two runs with lowest values of liquid Reynolds numbers. An analysis of this aspect of heat transfer using various assumptions is also included. Data are included on ratio of measured to estimated film coefficients and inferred film thicknesses. It is noted that the information on rate growth of a liquid film in a liquid droplet/vapor isothermal flow is speculative. A summary of work done to ascertain whether liquid thin film boiling can lead to bubble formation with heat transfer coefficients dependent more or less inversely on the film thickness is included. (J.R.D.)

**18270** (RT/FIMA(62)1) IL TRANSITO— UN PROGRAMMA FORTRAN IBM-704 PER IL CALCOLO DEI TRANSIENTI TERMICI IN UN REATTORE VELOCE. (The TRANSITO— A FORTRAN IBM-704 Program for the Calculation of Heat Transfer in a Fast Reactor). L. Biasini (Italy. Comitato Nazionale per l'Energia Nucleare. Centro di Calcolo, Bologna) and R. Evangelisti (Italy. Comitato Nazionale per l'Energia Nucleare. Laboratorio Ingegneria e Servomeccanismi Reattori, Ispra). Dec. 1962. 55p.

The TRANSITO program solves the heat transfer equations for the steady state and transient temperature distribution in a three-dimensional geometry (space and time), using a first-forward finite difference method to solve the system of differential equations. The dependence of the physical parameters on temperature is accounted for in the Fourier equations. Given the assembly's geometrical and physical description, the code yields the temperature distribution as a function of time. The mathematical approach and the nature of input-output data are given, and a sample calculation is presented along with the Fortran statements of the code. (auth)

**18271** (SAN-1003) STEADY STATE, NON-BOILING HEAT TRANSFER PERFORMANCE OF THE TEST SYSTEM. CONSTANT HEAT RATE TURBULENT FLAT PLATE AND RECTANGULAR CHANNEL FLOW HEAT TRANSFER TO WATER. H. A. Johnson, V. E. Schrock, and S. Fabic (California. Univ., Berkeley. Inst. of Engineering Research). Dec. 1962. Contract AT(11-1)-34. 39p.

Steady-state nonboiling heat transfer data and results are reported for tests on both the visual and x-ray chamber test sections. Correlation of these results indicates that the mean heat transfer coefficients are conservatively represented by either the turbulent flat plate flow equations or by the Hausen thermal entry length equation for fully developed channel flow. The x-ray chamber results are, however, about 15 to 20% high, compared with these equations and the results for the visual chamber. (auth)

**18272** (SAN-1009) SLUG FLOW CONDUCTION SOLUTION FOR EXPONENTIAL HEAT GENERATION IN A THIN FLAT PLATE. H. A. Johnson and P. L. Chambré (California. Univ., Berkeley. Inst. of Engineering Research). Jan. 1963. Contract AT(11-1)-34. 58p.

An analytic conduction solution is presented for the transient local and mean surface temperatures of a flat plate heated by a uniform exponential heat source and cooled on both surfaces by a fluid in slug flow. The effect of thermal capacity of the plate is included, but the internal resistance and conduction along the length are neglected. Numerical results are presented in tables and charts in terms of dimensionless arguments, and a comparison is made with a sample of experimental data. Since the solution is in closed form and numerically evaluated, it should be of value as a reference for testing approximate methods of analysis. That the latter will be necessary is illustrated by the comparison with experiment in which the effective heat transfer coefficient for this solution underestimates the experimental values by factors of 2 to 3. (auth)

**18273** (TID-18028) HIGH ACCELERATION FIELD HEAT TRANSFER FOR AUXILIARY SPACE NUCLEAR POWER SYSTEMS. Annual Technical Report, September 1, 1961 through August 31, 1962. H. F. Poppendiek, N. D. Greene, F. R. MacDonald, H. R. Wright, C. M. Sabin, and A. S. Thompson (Geoscience Ltd., Solana Beach, Calif.). Contract AT(04-3)-409. 157p. (GLR-10)

The auxiliary power research program by Geoscience which encompasses both fundamental liquid metal boiling and condensation heat transfer analyses and experiments in linear and high gravity flow through ducts is discussed. This research will permit the development of design correlations and criteria necessary for the prediction of nuclear reactor and heat exchanger performance in space power systems. A review and summary of post liquid metal heat and momentum transfer research, two-phase flow analyses, two-phase flow measurements, a comparison of analytical and experimental two-phase flow results, a boiling heat transfer system design, Mollier diagrams and physical properties for mercury and potassium, and a study of the influence of sudden coolant density changes on core heat transfer rates are presented. (H.G.G.)

**18274** (TID-18296) BASIC EXPERIMENTAL STUDIES OF BOILING FLUID FLOW AND HEAT TRANSFER AT ELEVATED PRESSURES. Monthly Progress Report for Month of February 1963. Bruce Matzner (Columbia Univ., New York. Engineering Research Labs.). Feb. 28, 1963. Contract AT(30-3)-187. 27p. (MPR-XIII-2-63)

During February 1962, 44 instrumented burnout points and 38 points for conditions beyond the instrumented burnout point were obtained for a bundle of 19 electrically heated rods with vertical upflow of boiling water at 1000 psig. This test section consisted of (19) 0.550 in. OD heater tubes on 0.633 in. centers with a 6 ft heated length and contained in a 3.195 in ID housing tube. Twelve of the rods were wrapped with 0.083 in. OD hypodermic needle tubing. The range of variables covered in these tests were: instrumented burnout heat flux, $0.25-0.74 \times 10^6$ Btu/hr-ft$^2$; exit steam quality, 17–60%; inlet subcooling, 20–295°F; mass velocity, $0.5-2.0 \times 10^6$ lb/hr-ft$^2$; max. d-c power input, 3.35 Mw. In general the burnout points for this 6-ft bundle were somewhat lower than those reported previously for 3-ft bundles of the same cross section. Above an exit quality of about 24%, a strong reverse mass velocity effect was observed which had not been noted for the shorter 3-ft bundles. The heat transfer coefficients measured at the downstream end of the test section were about 25% lower than those for the shorter 3-ft bundles. For the tests beyond the instrumented burnout point, heater wall temperatures of 700, 800, 900, and 1000°F were successively measured. Noted temperature rises were not of the very rapid type characteristic of the low quality nucleate boiling region. Only the wrapped rods showed evidence of severe overheating at the conclusion of the tests. (auth)

**18275** (UVA-245-62S) THE NONEXISTENCE OF PURE IMAGINARY EIGENVALUES AND THE UNIQUENESS THEOREM FOR THE LINEARIZED GAS FLOW EQUATIONS. John L. Ging (Virginia. Univ., Charlottesville. Research Labs. for Engineering Sciences). June 1962. Contract AT(40-1)-1779. 4p. (EP-4422-245-62S)

Arguments are presented to show that there are no solutions of the linearized equations that are periodic in the axial direction of the tube and hence, a proof of the nonexistence of pure imaginary eigenvalues. The uniqueness theorem for linearized gas flow equations is most easily proved in Cartesian coordinates. (H.G.G.)

**18276** (WAPD-T-1547) ANALYSIS OF GAS–LIQUID FLOW PATTERNS. E. Quandt (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). Nov. 1962. Contract AT(11-1)-Gen-14. 25p.

Gas–liquid flow in closed ducts is examined from the standpoint of the dominant physical forces acting on the system. Dimensionless criteria are developed in terms of the mixture Froude and Weber numbers for the prediction of the major flow patterns. These theoretical results are compared with the empirical correlation of Baker and are considered to be a significant improvement in the treatment of gas-liquid flow patterns. (auth)

**18277** (TRG-Inf-Ser-279) THE CHOICE OF LIMITING TEMPERATURE IN CALCULATIONS OF CONVECTIVE HEAT TRANSFER AND FRICTION IN DYNAMIC GAS CONDITIONS. S. I. Kosterin and Y. A. Koshmarov. Translated by G. R. Taylor (U.K.A.E.A. Risley, Lancs, Eng.) from Inzh.-Fiz. Zh., Akad. Nauk Belorussk. SSR, 3: No. 7, 3-9(1960). 7p.

The results of a study of the effect of limiting temperature, chosen by various methods, in calculations of convective heat transfer and friction in dynamic gas conditions are presented. To increase the accuracy of calculation, formulas for local values of temperature, corresponding to a given value of $Re_{\vartheta_x}$, are given. A generalization of experimental data for laminar friction is included. (H.G.G.)

**18278** (TRG-Inf-Ser-280) INVESTIGATION OF CONTACT HEAT EXCHANGE. Yu. (Y.) P. Shlykov, E. A. Ganin, and N. B. Demkin. Translated by M. McCarthy (U.K.A.E.A. Risley, Lancs, Eng.) from Teploenerg., 7: No. 6, 72-6(1960). 11p.

A method for the theoretical calculation of the magnitude of the thermal contact resistance between two rough surfaces with various compressive stresses and various surface finishes is presented. The heat transfer between the contacting surfaces takes place along two channels: through the gaseous layer and through the actual contact area. The total thermal resistance of contact is given by the equation: $1/R_\vartheta = 1/R_g + 1/R_\vartheta$, where $R_\vartheta$ is total thermal resistance, $R_g$ is thermal resistance of gaseous layer, and $R_\vartheta$ is thermal resistance of the actual contact area. Results show that individual components of the thermal resistance of contact ($R_g$ and $R_\vartheta$) are of the same order of magnitude over a wide range of loads; a change in the thermal resistance with load is caused basically by a

change of $R_6$; and when the stress is increased above 200 kg/cm$^2$, the total thermal resistance remains practically constant. (H.G.G.)

**18279** PRESSURE DROP FOR TWO-PHASE FLOW IN THE PIPE. I. THE THEORY OF PRESSURE DROP. Shigebumi Aoki, Tadaharu Ichiki, and Tadao Takahashi. Bull. Tokyo Inst. of Technol., Spec. No. 49, 127-39(1962). (In English)

In order to develop the theory of pressure drop for two-phase flow, the factors, which affect the pressure drop in the pipe, are discussed. At first the forces, which act on a single bubble are considered, and equations are given for the slip velocity ratio and for the void fraction. Secondly the correlation between the void fraction and the pressure loss is explained, and an equation is introduced for the multiplication factor, which is in good agreement with the experimental results given by other authors. (auth)

**18280** CHARACTERISTICS OF VAPOR ON A WALL HEATED IN BOILING WATER AT HIGH PRESSURE. Roger Semeria (Centre d'Études Nucléaires, Grenoble, France). Compt. Rend., 256: 1227-30(Feb. 4, 1963). (In French)

The kinematographic study of the boiling of water under pressure distinguishes three types of bubbles: bubbles in equilibrium, boiling bubbles, and coalescence bubbles. The principal characteristics of these types are indicated. (tr-auth)

**18281** A SEMI-RATIONAL NUCLEATE BOILING HEAT FLUX CORRELATION. J. H. Lienhard (Washington State Univ., Pullman). Intern. J. Heat Mass Transfer, 6: 215-19(Mar. 1963).

Tien's model for nucleate boiling heat transfer is re-examined in the light of a recent experiment by Benjamin and Westwater. The study leads to a semi-rational modification of his prediction, which gives better correlation of available data. (auth)

**18282** HEAT TRANSFER BIBLIOGRAPHY. E. R. G. Eckert, E. M. Sparrow, W. E. Ibele, and R. J. Goldstein (Univ. of Minnesota, Minneapolis). Intern. J. Heat Mass Transfer, 6: 231-42(Mar. 1963).

About 350 references are presented which are subdivided into sections dealing with applications, boundary layer flow, channel flow, phase changes, conduction, flow with separated regions, liquid metals, low-density heat transfer, magnetohydrodynamics, measurement techniques, natural convection, radiation, rotating surfaces, thermodynamics and transport properties, transfer mechanisms, and transpiration and mass transfer cooling. (D.L.C.)

**18283** TURBULENT HEAT TRANSFER IN A PARALLEL-PLATE CHANNEL. E. M. Sparrow and S. H. Lin (Univ. of Minnesota, Minneapolis). Intern. J. Heat Mass Transfer, 6: 249-9(Mar. 1963).

Analytical results are presented for the fully developed heat-transfer characteristics of a turbulent flow in a parallel-plate channel with uniform heat flux. The results were obtained by integration of the energy equation and are plotted on a Nusselt number vs Prandtl number graph for Reynolds numbers from $10^4$ to $5 \times 10^5$. Friction factors are also given as a function of Reynolds number. (D.L.C.)

**18284** THE CHARGE CARRIERS IN HIGHLY INSULATED LIQUIDS AND THEIR INFLUENCE ON HEAT TRANSFER. Hermann Senftleben and Peter Schnabel (Chemische Werken Huls A. G., Marl, Ger.). Z. Physik, 173: 29-38(1963). (In German)

In insulated liquids an electric field reduces the heat transfer. This decrease is related to the effects of electric space charges, which hinder the heat conduction. From the relaxation behavior of this effect it was concluded that insulated liquids always contain solvated charge carriers of both signs. They originate essentially in a mechanical way (for example in shaking or filtering the liquid) and probably have their cause in the separation of electric double layers. Charge carriers were also formed by gamma radiation, which produced the field-heat-transfer-effect. Limited additions of foreign materials increased the heat-transfer effect. (tr-auth)

## Materials Testing

**18285** (AD-281238) HIGH TEMPERATURE MATERIALS DEVELOPMENT. Progress Report No. 29, May 1962. (Raytheon Co. Research Div., Waltham, Mass.). June 15, 1962. Contract NOrd 19135 (FBM). 10p.

The flexural strength of a laminar structure comprised of alternate layers of pyrocarbide and pyrographite was found to be equal to that of pyrocarbide, the stronger component. In a carbon rich alloy of zirconium pyrocarbide, the strength is $92.9 \times 10^3$ psi, about four times stronger than pyrographite and twice as strong as cast iron. Tests are continuing to determine if these high strengths are reproducible and can be increased more by compositional changes. (auth)

**18286** (MAB-187-M(Vol.II)) DEPARTMENT OF DEFENSE PROGRAM ON MATERIALS RESEARCH AND DEVELOPMENT. VOLUME II. REPORTS OF TECHNICAL REVIEW COMMITTEES 2, 3, 5, 6, AND 7. (National Research Council. Materials Advisory Board). Dec. 31, 1962. 403p.

Various committee reports on materials research and development by the Department of Defense are presented. These reports include discussions of the "metal gap" method used in analyzing strength data for eight groups of metals, materials-design tradeoffs, the refractory metals coating problem, irradiation effects on structural metals, temperature-resistant, structural metal-bonding adhesives, advanced weapons study such as deep diving submarines, and weapons and vehicle mobility. (H.G.G.)

**18287** RADIOGRAPHY OF LARGE MISSILES WITH THE LINEAR ELECTRON ACCELERATOR. Jacob Haimson (Varian Associates, Palo Alto, Calif.). Nondestructive Testing, 21: 102-12(Mar.-Apr. 1963).

A major contribution toward insuring successful performance and safety of solid propellant missiles such as the Polaris, Skybolt, and Minuteman is the early detection of defects which may exist either at a depth within the propellant or at the bond between the casing liner and the fuel. The absence of flaws is of the utmost importance if a consistent burning rate and accurate flight trajectory are to be assured. Furthermore, it is necessary to detect even the smallest discontinuity in order to evaluate its influence upon the performance of a missile and to permit useful statistical data to be compiled from which minimal inspection specifications can be prepared. The missile industry's increasing demand for extreme sensitivity of flaw detection on a production basis required a new type of x-ray equipment with a capability heretofore unavailable. The main requirements for high energy radiographic inspection of large solid propellant missiles include: (1) Suitable choice of radiation energy to provide a compromise between minimum absorption, useful field cone size, and film unsharpness. (2) A source size of small dimensions to insure good resolution. (3) An intense x-ray output so that exposure time may be relatively short. (4) A flexible

system which can be easily maneuvered within the confines of a radiation cell. A brief description of high energy x-ray characteristics is given and their relationship to the above requirements is established. The radiographic linear electron accelerator is shown to meet these requirements, and some comparisons are made with previously available high energy equipment. Some theory and details of a specific radiographic linear accelerator are described, together with several special features that extend the versatility of this equipment. (auth)

# GEOLOGY, MINERALOGY, AND METEOROLOGY

*Refer also to abstract 19494.*

**18288** (A/AC.82/G/L.818) ENVIRONMENTAL RADIOACTIVITY IN HIGH BACKGROUND AREAS OF BRAZIL. Francisco X. Roser (Pontificia Universidade Católica, Rio de Janeiro) and Thomas L. Cullen (Fordham Univ., New York). Aug. 7, 1962. 111p.

A geotectonic belt encompassing the archeo-brazilian block in Brazil has numerous foci of intense mineralization closely related to the diastrophic phases of its evolution during the ages. Abundant mineral deposits and a number of hydrothermal spas are located along the belt and in many areas radioactive minerals are associated with the lines of fracture and with the upward diffusion of metallic and metalloidic elements to the surface, resulting in local infiltration or generalized contamination of the strata. Five different types of radioactive ore deposits have been distinguished. Results are reported from a 6000-kilometer field trip through the northern part of the state of Rio de Janeiro, the state of Espirito Santo, and the southern part of the state of Bahia. Measurements were made of the radiation levels. The survey was confined to regions where radiation levels were at least several times the normal background level. The survey was conducted as part of a study of the biological effects of chronic exposure to low levels of ionizing radiation. The geological features of the region are discussed in detail. Measuring instruments and methods are described and results of the survey are presented. (C.H.)

**18289** (AFOSR-2764) HYDROMAGNETIC KELVIN-HELMHOLTZ INSTABILITY SURFACE WAVES AND GEOMAGNETIC MICROPULSATIONS. Final Report. Amiya K. Sen (Columbia Univ., New York. School of Engineering). June 15, 1962. Contract AF49(638)-350. 75p. (AD-283988; CU-20-62-AF-350-EE)

The most general form of hydromagnetic Kelvin-Helmholtz discontinuity in ideal incompressible fluids was considered. The stability of the hydromagnetic flow of two uniform infinite streams with planar interface exhibiting this type of discontinuity was analyzed in detail. Necessary criteria for its stability were obtained. A disturbance of the stable interface propagates as hydromagnetic surface waves. Instability of the interface leads to growing surface waves. A new theory is developed of geomagnetic micropulsations, in which the solar wind-exosphere interface is viewed as a surface of hydromagnetic Kelvin-Helmholtz discontinuity. The sunlit side of this interface is unstable under most conditions of solar activity. In the course of this work, a critical examination of the single fluid approximations of the plasma equations was made. A rigorous derivation of the boundary conditions in an ideal incompressible hydromagnetic fluid is given. 66 references. (auth)

**18290** (NADC-AW-6226) PROTON PRECESSION MAGNETOMETER AS A STANDARD AT THE U. S. NAVAL AIR DEVELOPMENT CENTER. D. P. Miles and R. P. Lepping (Naval Air Development Center. Anti-Submarine Warfare Lab., Johnsville, Penna.). Sept. 14, 1962. 22p. (AD-284468)

A proton free-precession magnetometer, which makes use of the mechanical and magnetic properties of the proton to measure the total magnitude of the earth's magnetic field, is discussed. This instrument can serve as a secondary standard for the measurement of weak magnetic fields. The basis of this standardization is reviewed and tabular values of instrument count versus magnetic field are recorded for use with this instrument in the locality of Johnsville, Pennsylvania. (auth)

**18291** (NYO-9677) STRATOSPHERIC MONITORING PROGRAM SEMI-ANNUAL PROGRESS REPORT, JULY 1962–JANUARY 1963. M. Lippmann, comp. (Del Electronics Corp., Mount Vernon, N. Y.). Mar. 15, 1963. Contract AT(30-1)-2363. 71p.

Results of the continuing stratospheric flight test evaluation program for the Del Model I Electrostatic Precipitator Sampler and the Del Electrical Discharge Altimeter are described and discussed. Only one of four balloon launches reached floating altitude. The altimeter obtained an altitude recording consistent with concurrent aneroid barocoder readings. The reported gross $\gamma$ concentration for the precipitator sampler was ~25 and 80% higher than those of the two simultaneous direct flow filter samples. The completion of the design and construction of two prototype units of the Del Electrical Discharge Altimeter and their laboratory evaluation are described. A preliminary design concept is presented for an operational high volume electrostatic precipitator sampler to operate with high collection efficiency at an ambient flowrate of 500 cfm throughout the altitude range 100,000 to 150,000 ft. (H.G.G.)

**18292** (JPRS-18455) ATMOSPHERIC POLLUTION. Jan Juda and Karol Budzinski. Translation of "Zanieczyszczenia Atmosfery" (a publication of the Publishing House of Scientific-Technical Literature, Warsaw, 1961). 265p. (OTS-63-21460)

Information concerning the sources, dispersion, and investigation of atmospheric pollutants is presented in detail. Results of studies from foreign sources are given, and an attempt is made to analyze these data in the light of conditions prevailing in Poland. A systematic classification of atmospheric pollutants and damages resulting from atmospheric pollution is included. The influence of meteorological conditions on the dispersion of pollutants was investigated. Methods of measuring atmospheric pollution, determination of pollutant emission, estimation of dustfall, determination of particulate concentration in air, and determination of gaseous air pollutants are discussed. (H.G.G.)

**18293** PRELIMINARY FINDINGS ON THE RADIOACTIVE FALLOUT DUE TO NUCLEAR DETONATIONS. Yasushi Nishiwaki. Bull. Tokyo Inst. Technol., Spec. No. 49, 205-27(1962). (In English)

Based upon the preliminary findings of the radioactive fallout due to nuclear detonations, the methods of sampling which may be suitable for continuous routine measurement of the artificial radioactivity in the rain water are discussed. The decay curves and the absorption curves of the beta rays detected from the different rain falls during early period are compared and the problem of possible complication with some of the relatively short lived naturally occurring radioactivities due to Rn or Tn are also discussed. In order to check whether such a degree of radioactive contamination as observed in Japan would be possible, an order of magnitude estimation of the radioactive fallout is discussed assuming the fission-fusion fission type of nuclear device. Some discussions are made on the permissible and

the warning levels of the radioactive nuclides which may be considered relatively important from the health physics point of view. (auth)

**18294** ON THE METHOD OF ESTIMATING THE PROBABLE TIME OF NUCLEAR DETONATION FROM THE MEASUREMENTS OF GROSS-ACTIVITY. Yasushi Nishiwaki. Bull. Tokyo Inst. Technol., Spec. No. 49, 229-53 (1962). (In English)

From health physics point of view it is oftentimes important to estimate very quickly the average age of the fission products in order to assess the relative hazard of strong but short-lived components of radioactive fallout. For this purpose it may be necessary to estimate the probable time of nuclear detonation based upon the measurement of gross activity of the fallout. According to past experiences the decay of the gross activity of the fallout may be approximated by the Way-Wigner relation during the initial period from a few days to about a month after the nuclear detonation, although the value of the exposed of "t" the time after detonation was observed to be somewhat different with such conditions as the method of sampling and measurement, the meteorological conditions, and presumably also the type of nuclear detonation and other various factors. Therefore assuming the Way-Wigner relation a priori, various methods of estimating "t" and the exponent of "t" and of dating the nuclear detonation from the decay measurements of gross activity of fallout are introduced and some of the results are discussed. (auth)

**18295** ON THE ARTIFICIAL RADIOACTIVITY IN THE RAIN OF OSAKA DURING THE PERIOD FROM APRIL 1954 TO THE END OF AUGUST 1961. Yasushi Nishiwaki. Bull. Tokyo Inst. Technol., Spec. No. 49, 255-92(1962). (In English)

An analysis of the results of the routine measurements of the radioactive fallout are introduced. The frequency distributions of the amounts of rainfalls as well as those of the gross activity detected in the fallout in Osaka, Japan during the period from April 1954 to the end of August 1961 are presented. The preliminary results of the radiochemical analysis of strontium-90 and cesium-137 are discussed and the correlations between the gross activity of the rain and the activities of strontium-90 and cesium-137 are given. Some of the difficulties associated with the method and the site of collecting rainwater or sampling for the purpose of detecting strontium-90 and cesium-137 are pointed out and discussed in comparison with other data given by different institutes in Japan. (auth)

**18296** CESIUM SORPTION REACTIONS AS INDICATOR OF CLAY MINERAL STRUCTURES. Tsuneo Tamura (Oak Ridge National Lab., Tenn.). Clays Clay Minerals, Proc. Natl. Conf. Clays Clay Minerals, 10: 389-98(1963).

At low cesium ion concentrations extremely high selectivities for cesium are exhibited by layer lattice silicates with unexpanded 10 Å c-spacing. The total amount of cesium which can be sorbed by these minerals depends on the edge area and the exchange capacity. At a concentration of $10^{-5}$ meq of cesium and 5 meq of sodium, a sample of biotite representing less than 0.025 meq of exchange capacity sorbed over 90% of the cesium and a hydrobiotite with 50% vermiculite and representing 1.0 meq of exchange capacity sorbed 80% of the cesium. After heating bentonites to 500 to 700°C more cesium was sorbed from solutions containing high sodium concentrations by the heated bentonite than the original material. The change in the amount of cesium sorbed as a result of heating may be a useful property for detecting the presence of montmorillonite in mixed or interlayered mineral systems. Lattice expansion of biotite resulted in improved cesium sorption; this behavior was due to generation of sufficient favorable exchange sites to offset the loss of edges with favorable 10 Å spacing. (auth)

**18297** ISOTOPIC COMPOSITION OF AUSTRALIAN LEADS. III. NORTHWESTERN QUEENSLAND AND THE NORTHERN TERRITORY—A RECONNAISSANCE. J. R. Richards (Australian National Univ., Canberra). Geochim. Cosmochim. Acta, 27: 217-40(Mar. 1963).

Lead isotopic abundances are reported for a number of samples from Northern Australia, principally from the Mount Isa region of Queensland and Rum Jungle in the Northern Territory. Model ages ($t_{6-7}$ of Russell and Farquhar, 1960) are deduced for Broken Hill, NSW, 1590 my; Mount Isa, 1570 my; and for Rum Jungle, where some lead of anomalous behavior is also found, 1520 my. After some discussion of sources of error, the tentative suggestions are made that the Dugald River deposits are the same age as those at Mount Isa; and that the radiogenic contamination at Rum Jungle may have taken place over a long period of time by some non-catastrophic process. Finally, an example was found, in the Macarthur River area, of lead which appears on present evidence to be considerably older (Lower Proterozoic) than the sediments (Upper Proterozoic) with which it is syngenetically associated. (auth)

**18298** HAFNIUM IN THE ROCK G-1 DETERMINED BY NEUTRON-ACTIVATION ANALYSIS. D. F. C. Morris and D. N. Slater (Brunel Coll., London). Geochim. Cosmochim. Acta, 27: 285(Mar. 1963).

Replicate analyses for Hf were carried out on the rock G-1 supplied by the U. S. Geological Survey. The results fell in the range of 7.5 to 7.6 ppm Hf. (D.L.C.)

**18299** THE APPLICATION OF PHYSICAL AND CHEMICAL METHODS TO GEOCHRONOLOGY. E. I. Hamilton, M. H. Dodson, and N. J. Snelling (Oxford Univ.). Intern. J. Appl. Radiation Isotopes, 13: 587-610(Nov.-Dec. 1962). (In English)

Physical and chemical methods used in geochronology are reviewed. Methods used for measuring the age of rocks are based on the decay of the long-lived radioactive isotopes $K^{40}$, $Rb^{87}$, $U^{238}$, $U^{235}$, and $Th^{232}$. Analyses by isotope dilution were developed to a high degree of accuracy and sensitivity for this purpose. Uncertainties in the decay constants are now comparable with or less than the analytical uncertainties inherent in this method. Recent events (~$10^5$ years) can be investigated using $C^{14}$, $Th^{230}$, and $P^{231}$. The history of meteorites is studied by examining radioactive and stable nuclides produced by cosmic rays. Low-level counting techniques were improved for this purpose, and gas mass spectrometers of very high sensitivity were built. The age of the earth and meteorites is thought to be 4550 million years. The oldest identifiable fossil remains are ca. 600 million years old, while the oldest known rocks are 3500 million years old. 156 references are cited. (P.C.H.)

**18300** DATA ON RADIOACTIVE MATERIAL DISTRIBUTION ALONG A NORMAL INTERFACE. I. D. Savitskii. Izv. Akad. Nauk SSSR, Ser. Geofiz., No. 2, 329-32(Feb. 1963). (In Russian)

A screening detector was used for measuring the angular distribution of radioactive materials during sampling and logging operations. (R.V.J.)

**18301** THE BOUNDARY OF THE GEOMAGNETIC FIELD. L. J. Cahill and P. G. Amazeen (Univ. of New

Hampshire, Durham. J. Geophys. Res., 68: 1835-43 (Apr. 1, 1963).

A three-component magnetometer was carried on Explorer 12, launched on August 16, 1961. The boundary of the geomagnetic field on the sunlit side of the earth was observed. During magnetically quiet periods the boundary, near the earth-sun line, was at approximately 10 earth radii distance. During the period of observation a field of magnitude 30 to 40 gammas existed outside the boundary; it was usually directed downward, or southward, from the ecliptic plane. The boundary was stable, and magnetic fluctuations inside the geomagnetic field were relatively small although often large outside. (auth)

**18302** ATMOSPHERIC CIRCULATION FROM OBSERVATIONS OF SODIUM 22 AND OTHER SHORT-LIVED NATURAL RADIOACTIVITIES. N. Bhandari and Rama (Tate Inst. of Fundamental Research, Bombay). J. Geophys. Res., 68: 1959-66(Apr. 1, 1963).

The radioactivities of the cosmic-ray-produced nuclides $Be^7$, $S^{35}$, and $Na^{23}$ are measured in samples of dust filtered at a number of points in the atmosphere. It is found that the short-lived activities of $Be^7$ and $S^{35}$ are in approximate secular equilibrium with their local production at altitudes of 18 to 20 km. The degree of saturation exceeds 50 per cent of the equilibrium value even in regions just above the tropopause. The observed activities of the longer-lived isotope $Na^{22}$ are, however, found to be considerably undersaturated throughout the lower stratosphere (up to altitudes of about 20 km). The departure from the equilibrium values is found to be strongly altitude-dependent; in regions close to the tropopause the activities are observed to be an order of magnitude lower than those expected, whereas at altitudes of 18 to 20 km they reach about 50 per cent of the expected equilibrium values. These data clearly show that the measurements of natural activities whose half-lives are shorter than 3 months are not adequate by themselves for the study of the nature of transport and mixing in the stratosphere. $Na^{22}$ (half life = 2.6 years) is suited for the studies of stratospheric circulation, and studying it along with any of the short-lived isotopes, e.g., $Be^7$ or $P^{32}$, should prove useful. The data are not extensive; nevertheless, they are sufficient to test the validity of certain important aspects of various models of circulations. (auth)

**18303** IONOSPHERIC EFFECTS OF HIGH-ALTITUDE NUCLEAR TESTS. H. R. Willard and James F. Kenney (Boeing Scientific Research Lab., Seattle). J. Geophys. Res., 68: 2053-6(Apr. 1, 1963).

Effects of high-altitude U.S. and Russian nuclear explosions in 1962 on the phase advances and amplitudes of VLF signals (stations WWVL and NPM) are reported and interpreted. The signal fluctuations are correlated with ionospheric effects. (T.F.H.)

**18304** ELECTROMAGNETIC EFFECTS FROM HIGH-ALTITUDE NUCLEAR EXPLOSIONS. F. Kirk Odencrantz (Naval Ordnance Test Station, China Lake, Calif.). J. Geophys. Res., 68: 2057(Apr. 1, 1963).

Electromagnetic pulses observed between 0 and 410 sec after nuclear explosions are noted. The pulses arrive singly, at discrete intervals. Propagation mechanisms for the pulses are discussed. (T.F.H.)

**18305** SEASONAL VARIATIONS OF CAESIUM-137 IN AIR AT GROUND-LEVEL DURING 1960 AND 1961. K. G. Vohra, C. Rangarajan, and G. Sarada (Atomic Energy Establishment, Trombay, India). Nature, 197: 1092(Mar. 16, 1963).

Measurements on radioactive fallout in air and rainwater in India during 1960 and 1961 showed that during late winter and spring an increase in cesium-137 appeared at ground level. (C.E.S.)

**18306** GEOGRAPHICAL VARIATIONS OF OXYGEN-18/OXYGEN-16 RATIO IN SURFACE SNOW AND ICE FROM QUEEN MAUD LAND, ANTARCTICA. R. Gonfiantini (Università, Pisa, Italy), V. Togliatti, E. Tongiorgi, W. de Breuck, and E. Picciotto. Nature, 197: 1096-8 (Mar. 16, 1963).

The ratio of oxygen-18 to oxygen-16 was measured in samples of surface snow and ice in Queen Maud Land, Antarctica. The samples were collected during 1959 and 1960. Results relative to samples of one or more years of accumulation are reported in order to minimize the seasonal variations. (C.E.S.)

**18307** IONS OF EXTRA-TERRESTRIAL ORIGIN IN THE EARTH'S IONOSPHERE. V. G. Istomin. Planetary Space Sci., 11: 173-81(Feb. 1963). (Translated by J. Cornish from Iskusst. Sputniki Zemli, No. 11, p.98(1961).)

Two of the tasks of the third Russian satellite were to determine the chemical composition of the main ion components in the earth's daytime ionosphere and to study the variation in composition in the main components with altitude in the E, $F_1$, and $F_2$ regions of the ionosphere. In some of the measurements, ions were discovered in the nitrogen-oxygen atmosphere that required additional explanation from the point of view of their origin and the nature of the possible ionizing agents. Over 100 spectra were obtained at altitudes between 92 and 206 km. The results confirm the hypothesis of the predominant role of meteors in the nighttime ionization in the E region, and it is quite probable that with certain improvements the analysis of the mass spectrum can be used to determine the composition of meteors with sizes that preclude their reaching the earth. (C.E.S.)

**18308** GAMMA-RAY SPECTROMETRIC DETERMINATION OF SMALL AMOUNTS OF Zr-, Nb-95 IN SOIL SAMPLES OF NIIGATA CITY AND THE SHINANO RIVER-BED. Shokichi Sakagishi, Kaoru Ueno, and Kentaro Minami (Japan Atomic Energy Research Inst., Tokyo). Radioisotopes (Tokyo), 12: 11-17(Feb. 1963). (In Japanese)

In the gamma spectra of soil the presence of several peaks that cannot be assigned to any natural nuclide was found. It is clear that these peaks are due to radioactive fission products that are produced from nuclear weapon tests. The gamma spectra of soil samples of Niigata City and the Shinano River-bed collected in May 1962 show three peaks. Peaks at 0.14 and 0.5 Mev are actually a combination of peaks of Ce-141, Ce-144, Pr-144 and Ru-103, Rh-106, respectively, while the 0.76 Mev peak is assigned to Zr-95, Nb-95. Amounts of Zr-95, Nb-95 were determined by means of the standard comparison method. A soil sample of 150 grams contained about 0.5 to 30 mμC Zr-95, Nb-95. (auth)

**18309** THE DETECTION OF UNDERGROUND EXPLOSIONS. L. Don Leet (Harvard Univ., Cambridge, Mass.). Sci. Am., 206: 55-9(June 1962).

A discussion is presented on seismological aspects of underground nuclear explosions and criteria for distinguishing them from earthquakes. (H.H.D.)

**18310** CARBON ISOTOPE ABUNDANCE IN METEORITIC CARBONATES. Robert N. Clayton (Univ. of Chicago). Science, 140: 192-3(Apr. 12, 1963).

The $C^{13}/C^{12}$ ratio in the carbonate minerals of Orgueil, a carbonaceous chondrite, is 6 percent greater than the ratio in any known terrestrial carbon. The effect may be produced by a chemical isotope fractionation involving processes not common on earth, or it may be the result of in-

complete homogenization of substances with different histories of nucleosynthesis. (auth)

**18311** BULLETIN OF THE ATMOSPHERIC RADIOACTIVITY, NO. 29, APRIL-JUNE, 1962. Tokyo, The Japan Meteorological Agency, 1962. 97p. (In English and Japanese)

Radioactivity measurements in April to June 1962 are reported for 14 stations in Japan. The data include activities of rain collected at a fixed time daily, in the initial 1 mm of rain, of dusts, and of sea water. (D.L.C.)

**18312** NEW DATA ON RARE ELEMENT MINERALOGY. A. I. Ginzburg, ed. Authorized Translation from the Russian. New York, Consultants Bureau Enterprises, Inc., 1963. 143p. $17.50.

An 18-paper survey of rare-element deposits is presented which gives new data and reviews inaccessible data. The properties of minerals susceptible to analysis are reported. A bibliography is included. (D.L.C.)

**18313** NATURAL GAMMA AERORADIOACTIVITY OF THE GEORGIA NUCLEAR LABORATORY AREA, GEORGIA. Jules A. MacKallor (Geological Survey, Washington, D. C.). Geophysical Investigations Map GP-351. 1963. $0.50(USGS).

# HEALTH AND SAFETY

*Refer also to abstracts 17708, 17710, 17745, 17747, 17748, 17792, 17813, and 19696.*

**18314** (A/AC.82/G/L-808) CONTAMINACIÓN POR $I^{131}$ DEBIDA AL FALL-OUT. INFORME NO. 75. (Contamination by I-131 from Fall-out. Report No. 75). D. Benninson and E. Ramos (Argentina. Comisión Nacional de Energiá Atómica, Buenos Aires). 1962. 9p.

The mean levels of $I^{131}$ in the milk of Buenos Aires from the last of April to the last of July 1962 were determined, and the significance of the results was discussed. The results showed that from May 16 to the first days of July there was a detectable iodine activity in the milk. An estimation was made of the thyroid dose received at different ages from the milk contamination. (J.S.R.)

**18315** (AD-283680) MONTHLY PROGRESS REPORT ON THE FEASIBILITY AND DESIGN STUDY FOR COLLECTIVE PROTECTION EQUIPMENT FOR THE AN/MSG-4 SYSTEM. PHASE IA. Technical Report, April 15 to May 30, 1962 (1st Report). Financial Report, April 15 to May 30, 1962 (1st Report). GSG Report No. 1663.00/54. J. Glaser (Hughes Aircraft Co., Culver City, Calif.). June 19, 1962. Contract DA-18-108 CML-6618. 10p.

Initial efforts devoted to development of layout drawings of the protective equipment from which detailed fabrication drawings are to be established are reported. Collective protection equipment design progress is reported on 400- and 800-cfm filter units and on protective entrances for shelters and vehicles. (J.R.D.)

**18316** (AECL-1700) RECENT ADVANCES IN PERSONNEL DOSIMETRY AT CHALK RIVER. G. Cowper (Atomic Energy of Canada Ltd., Chalk River, Ont.). Feb. 1963. 25p.

Developments in film dosimetry including the design of a new film dosimeter, personal warning dosimeters, various applications of pulse counters to the determination of radiation dose rate, the use of thin scintillator techniques for beta dose rate measurement, and activation techniques for neutron dosimetry are described. Limitation of these various methods and their application to existing operating problems are discussed. (auth)

**18317** (AHSB(S)R-19) THE TRANSPORT OF RADIOACTIVE MATERIALS. INTERIM RECOMMENDATIONS FOR THE APPLICATION OF ENVIRONMENTAL TESTS TO THE APPROVAL OF PACKAGING. W. de L. M. Messenger and A. Fairbairn (United Kingdom Atomic Energy Authority. Authority Health and Safety Branch, Risley, Lancs, England). Nov. 27, 1962. 126p.

A survey of radioactive material transport environments is presented. Corresponding environmental tests are proposed which may be used, when necessary, to demonstrate that packaging designs for these materials comply with the appropriate standards. (J.R.D.)

**18318** (AHSB(S)R-45) THE REMOVAL OF IODINE FROM THE ATMOSPHERE BY SPRAYS. V. Griffiths (United Kingdom Atomic Energy Authority. Authority Health and Safety Branch, Risley, Lancs, England). Dec. 3, 1962. 28p.

The removal of $I_2$ from reactor containment atmospheres by sprays is examined. It was found that liquid sprays which combine chemically with $I_2$ could reduce the non-particulate concentration to 0.1% of the original in a few minutes. Removal of $I_2$ by water sprays is limited by the partition of $I_2$ between the containment atmosphere and water. The fate of $I_2$ and other fission products absorbed on was not determined. (J.R.D.)

**18319** (CRRD-1136) ANALYSIS OF RADIATION EXPOSURES DURING 1962. G. Cowper and P. C. Rowe (Atomic Energy of Canada Ltd., Chalk River, Ont.). Mar. 1963. 9p. (AECL-1703)

External radiation exposures received by Atomic Energy of Canada Limited workers in 1962 were analyzed by machine accounting methods. The data are presented. (auth)

**18320** (DASA-1341) THE ENVIRONMENTAL MEDICAL ASPECTS OF NUCLEAR BLAST. Technical Progress Report. Clayton S. White, I. Gerald Bowen, and Donald R. Richmond (Lovelace Foundation for Medical Education and Research, Albuquerque, N. Mex.). Nov. 1962. Contract DA-49-146-XZ-055. 76p.

The nature of certain critical lesions seen after exposure to air blast is described. The early lethality characterizing primary and tertiary blast damage is emphasized along with the seriousness of injuries caused by blast-energized debris. Tentative criteria are developed to the end that different levels of environmental variations caused by blast phenomena could be quantitatively related to various levels of biological response. Using the free-field scaling laws and a mathematical model whereby translational velocities can be computed for animate and inanimate objects, the criteria are applied to nuclear explosions ranging in yield from 1 kt to 100 Mt. Thus, it is possible to specify, as a function of yield, the hazard ranges inside which various blast injuries might occur. At these ranges the associated levels of initial nuclear and thermal radiation were computed to allow at least some assessment of the relative importance of all the major hazards from nuclear detonations. (auth)

**18321** (DPSPU-63-30-8) BACKGROUND RADIATION MEASUREMENTS IN THE ENVIRONS OF THE SAVANNAH RIVER PLANT, 1952-1963. J. E. Hoy and L. F. Landon (Du Pont de Nemours (E. I.) & Co. Savannah River Plant, Aiken, S. C.). Mar. 1963. Contract AT(07-2)-1. 13p.

Results of an 11-year survey of the natural gamma radiation in the Savannah River Plant environs are presented along with descriptions of instruments used. Rechargeable ionization chambers used in the measurements were found to be adequate to detect long-term trends in radiation levels. (J.R.D.)

**18322** (HASL-135) FALLOUT PROGRAM QUARTERLY SUMMARY REPORT, DECEMBER 1, 1962 THROUGH MARCH 1, 1963. Edward P. Hardy, Jr., Joseph Rivera, and William R. Collins, Jr. (New York Operations Office. Health and Safety Lab., AEC). Apr. 1, 1963. 312p.

Current data are presented from the HASL Fallout Program, the U. S. Naval Research Laboratory, the New Zealand Department of Scientific and Industrial Research, and the Dominion X-Ray and Radium Laboratory in New Zealand. Radionuclide levels in fallout, milk, tap water, and upper air samples are given in tabular form. Interpretive reports and notes dealing with world-wide strontium-90 fallout through May 1962, latitudinal spread of 1961 U.S.S.R. nuclear debris, strontium-90 levels in

infant and adult diet and bone, and a comparison between two monthly fallout collection devices, are included. (auth)

**18323** (HW-73891(Rev.)) A METHOD FOR IMMEDIATE DETECTION OF HIGH LEVEL NEUTRON EXPOSURE BY MEASUREMENT OF SODIUM-24 IN HUMANS. R. H. Wilson (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). July 31, 1962. Contract AT(45-1)-1350. 11p.

A procedure is described for the quick identification of persons exposed to neutrons by direct body survey. Neutrons are captured by natural $Na^{23}$ contained in the body to produce $Na^{24}$, which decay by $\beta$ emission to $Mg^{24}$. Gamma rays with energies of 1.37 and 2.75 are emitted and may be detected outside of the body by a portable GM-type radiation survey instrument placed against the abdominal area. A general relationship was developed between body weight, count rate, and dose that gives a good estimate of the neutron dose received. (C.H.)

**18324** (HW-76944) THE NEW HANFORD FILM BADGE DOSIMETER. L. F. Kocher, P. E. Bramson, and C. M. Unruh (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Mar. 1, 1963. Contract AT(45-1)-1350. 25p.

A common problem in personnel dosimetry is the measurement of radiation dose with personnel dosimeters when several types and energies of radiation may be present concurrently. The new Hanford film badge dosimeter was designed to solve this problem to the best extent possible within the available film dosimetry technology. This dosimeter utilizes the latest advances in film filter systems for routine dose evaluations and provides high neutron dose and high gamma dose evaluation capabilities following a serious radiation event. The new Hanford personnel film badge dosimeter was placed into routine service at Hanford on August 10, 1962. The dosimeter measures 8 cm × 4.5 cm × 0.9 cm and weighs 34 grams. It is molded from "Cycolac" plastic (Styrene–butadiene–acrylonitrile). The dosimeter provides for the evaluation of radiation dose from beta, gamma and x-ray radiations present independently or concurrently. Activation foils provide neutron dosimetry in the event of a criticality or similar radiation event. Two small silver phosphate glass rod dosimeters (fluorods) are included to provide measurement of high gamma dose. Indium foil is provided for prompt sorting of directly-involved personnel following a criticality event. The dosimeter was designed to take full advantage of mechanized processing. Each dosimeter contains a lead tape perforated with the employee's payroll number. A binary number code is used for the payroll number to facilitate machine reading. Prior to the removal of the film packet, the payroll number is x-rayed onto a part of the film to provide positive and permanent identification. Film identification and film exchange are performed mechanically by a film dosimeter processing machine. The film slide is held in the dosimeter by a "T" lock which is released magnetically for film exchange. The dosimeter is designed to be relatively "tamper-proof" and it cannot be easily opened without a special magnet. The dosimeter design provides for use of the Hanford security credential in a neat integrated assembly. The security credential is removable from the dosimeter and can be readily removed by the wearer for dosimeter exchange. (auth)

**18325** (HW-SA-2730) DOSIMETRY INVESTIGATION OF THE RECUPLEX CRITICALITY ACCIDENT. C. C. Gamertsfelder, H. V. Larson, J. M. Nielsen, W. C. Roesch, and E. C. Watson (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). [Aug. 22, 1962]. Contract AT(45-1)-1350. 32p.

The dosimetry investigation made following a criticality accident in a Pu waste chemical recovery plant is described. Four men were hospitalized as a result of the accident but were released after medical observation. (J.R.D.)

**18326** (IDO-16846) MANUAL OF PROCEDURES FOR EFFECTING CONTROL OF SS MATERIALS AT STATION SSI. B. S. Lewis and F. H. Tingey (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). Feb. 19, 1963. Contract AT(10-1)-205. 46p.

A manual is presented which contains accounting procedures for receiving, storing, handling, shipping, and inventorying all source and special nuclear materials at Station SSI (Test Area North) at the NRTS. (J.R.D.)

**18327** (LF-6) OPERATING CHARACTERISTICS OF THE LAUTERBACH AND DAUTREBANDE AEROSOL GENERATORS. Technical Progress Report. T. T. Mercer, M. I. Tillery, and M. A. Flores (Lovelace Foundation for Medical Education and Research, Albuquerque, N. Mex.). Feb. 1963. Contract AT(29-2)-1013. 32p.

The operating characteristics of the Lauterbach and Dautrebande aerosol generators were studied. The output, in terms of microliters of solution aerosolized per liter of air passing through the jet, was not appreciably affected by either the diameter of the jet orifice or the concentration of the solution. The output increased with increasing pressure drop, $\Delta P$, across the jet orifice, approaching an asymptote apparently negligibly greater than the output at $\Delta P = 50$ psi. The median diameters of the particle size distributions were unaffected by either orifice diameter or jet pressure. They varied with solution concentration but to a lesser extent than was expected. Mass median diameters, however, showed an effect of jet pressure as well as solution concentration. The air flow through the jet, the effect of a pre-humidifier on the water vapor content of the jet air, the cooling effect of the jet air on the generator solution, and the amount of water vapor carried away by the jet air were also determined and the results are discussed. (auth)

**18328** (NSEC-89) ANALYSIS AND EVALUATION OF FALLOUT RADIOACTIVITY IN PITTSBURGH PRECIPITATION. R. C. Koch and C. R. Wilson (Nuclear Science and Engineering Corp., Pittsburgh). Feb. 1963. Contract AT (30-1)-3072. 32p.

Results of the investigation conducted by NSEC of selected radionuclides associated with debris from atmospheric nuclear detonations in precipitation samples collected at Pittsburgh during the period Nov. 1962 through Jan. 1963 are presented. This program involves experimental measurements of the deposition rates of the respective radionuclides and of their concentrations in Pittsburgh precipitation, and the correlation of the experimental data for individual precipitations with general meteorological parameters. Statistical correlations existing between the radiochemistry and meteorology data for these events permit a better understanding of the phenomena effective in the transport of nuclear debris from the stratosphere to the ground. These investigations were divided into two phases: experimental measurements of monthly deposition rates of the radionuclides, and an evaluation program, including experimental studies with individual precipitations, the collation and classification of meteorological data for these precipitation events, and the search for correlations

between these data and the concentrations of pertinent fission-produced radionuclides in the precipitation samples. (H.G.G.)

**18329** (NYO-10495) HIGH ALTITUDE BALLOON SAMPLING PROGRAM. Quarterly Report No. 2. Fernando Bazan, A. Bruce Caridi, Jean M. Christian, Philip W. Krey, and Colin G. Sanderson (Isotopes, Inc., Westwood, N. J.). Apr. 1, 1963. Contract AT(30-1)-3071. 58p.

Procedures developed for the radiochemical sequential separation of $Be^{7}$, $Mn^{54}$, $Fe^{55}$, $Sr^{89}$, $Sr^{90}$, $Y^{88}$, $Y^{91}$, $Zr^{95}$, $Rh^{102}$, $Cd^{109}$, $Sb^{124}$, $Sb^{125}$, $Cs^{137}$, $Ba^{140}$, $Ce^{141}$, $Ce^{144}$, $Pm^{147}$, $Tl^{204}$, and Pu are presented. Purification and radiometric procedures for $Fe^{55}$, $Y^{88}$, $Y^{91}$, $Cd^{109}$, $Sb^{124}$, $Sb^{125}$, $Pm^{147}$, $Tl^{204}$, and Pu are also included along with procedures for dissolution of polystyrene and aqua-dag samples. Research is also reported on identification of the 1.8-Mev photon-emitting radionuclide observed on the gamma spectrum of a sample collected at 79,000 ft at 31°N latitude. Results of radiochemical quality control work are included. (J.R.D.)

**18330** (ORNL-TM-507) RADIATION SAFETY AND CONTROL AT THE OAK RIDGE NATIONAL LABORATORY, 1960-1962. F. R. Bruce (Oak Ridge National Lab., Tenn.). Apr. 5, 1963. Contract [W-7405-eng-26]. 26p.

Activities of the radiation safety program at Oak Ridge National Laboratory for the period 1960-1962 are described. A reduction in the frequency of radiation accidents was observed and a training program for technical and nontechnical personnel has been formulated. Sixteen facilities were improved to ensure safe operation at a cost of approximately $2,388,589. A comprehensive Radiation Warning and Communication System is being installed in three phases over a period of three years ending in FY 1964. (auth)

**18331** (ORNL-TM-531) COMPARISON OF HAND EXPOSURE DATA WITH FILM BADGE METER RESULTS. A. D. Warden (Oak Ridge National Lab., Tenn.). Apr. 1, 1963. Contract W-7405-eng-26. 7p.

A study and comparison of the skin and penetrating doses of radiation measured by the ORNL Hand Exposure Meter with like doses recorded by the UCNC Film Badge Meter is presented. Conclusions were reached that the ratio of hand to whole-body exposures typically shown is sufficiently variable to warrant prudent and careful use of hand exposure meters. This monitoring should be employed, particularly, for work involving low energy and short range emitters as well as operations over a barricade shield when a person may possibly receive in one monitoring quarter a dose to the hands >2500 mrem. (H.G.G.)

**18332** (ORO-587(Vol.I)) AN ECOLOGICAL SURVEY OF WHITE OAK CREEK, 1950–1953. Louis A. Krumholz (Tennessee Valley Authority, Norris, Tenn.). Feb. 1954. Contract AT(40-1)-221. 164p.

Data are presented from an ecological survey, conducted from 1950 through 1953, of White Oak Creek. Atomic wastes from Oak Ridge National Laboratory were impounded in White Oak Lake. Data are presented on the effects of radioactive wastes on the flora and fauna indigenous to the drainage area of White Oak Creek. The survey revealed no unusual conditions directly attributable to radiation exposure. Data and observations are presented on all plants and animals in the area. (C.H.)

**18333** (SAN-1022) APPLICATION OF RADIOCHEMISTRY TECHNIQUES IN FOOD PROCESSING RESEARCH. RADIOISOTOPIC TRACER TECHNIQUES IN EVALUATION AND IMPROVEMENT OF INDUSTRY PRACTICES FOR REMOVAL OF PESTICIDE RESIDUES FROM FOODS. Annual Report. Walter A. Mercer, ed. (National Canners Assn. Western Research Lab., Berkeley, Calif.). Feb. 1963. Contract AT(04-3)-296. 93p.

Radiochemical techniques have provided a critical evaluation of the efficiency of procedures for the extraction of pesticides from tomato pomace, selected as a good source of residues from commercially applied pesticides and as a suitable test material for laboratory application of radioactive pesticides. Contrary to the generally accepted assumption, multiple extractions were required to recover more than 60% of added DDT-$C^{14}$. The highest recovery of pesticide (82%) was obtained using three extractions with acetonitrile. An improved extraction method is described which eliminates a transfer of the pomace and provides higher recoveries in shorter times. Two combustion furnaces were constructed, each of which allows for the simultaneous combustion of three residue samples followed by collection of $C^{14}O_2$ and $H^3O_2$ for liquid scintillation counting. Using this combustion and collection system, the average recovery value for added $C^{14}$ was 98.5%; the recovery of added $H^3$ averaged 89%. Procedures for the clean-up of food extracts prior to pesticide residue analysis were evaluated using radiochemical techniques. The procedures studied were batch charcoal absorption and column chromatography with polyethylene-alumina, florisil, and silica gel-alumina. The recovery of DDT-$C^{14}$ from benzene solutions treated with 1 : 5 Nuchar-Attaclay was 92%. This result was achieved using an adsorbent to solvent ratio of 1 : 20 in place of the ratio of 1 : 10 generally used. The recovery of DDT-$C^{14}$ from tomato pomace extract was 93 to 97%. These results demonstrated that charcoal clean-up removed materials which interfere with subsequent analyses without significant loss of sample. The recovery of 24 pesticides from a Norit-Florisil column was measured by paper chromatography and fly bioassay. This adsorbent was effective for the removal of tomato and spinach pigments from extracts prior to analysis by paper chromatography. The recovery of DDT-$C^{14}$ from tomato pomace extract using a polyethylene-alumina column was highly erratic with values varying from 73 to 92%. The removal of interfering materials was poor using this procedure. The recovery of aldrin-$C^{14}$, dieldrin-$C^{14}$, and DDT-$C^{14}$, following a Florisil column clean-up, was high and the reproducibility was excellent. A modification of the established method is described which reduces elution volumes and time while maintaining high recoveries. The performance of the silica gel-alumina columns was equivalent to that of the Florisil columns in recoveries of aldrin-$C^{14}$, dieldrin-$C^{14}$, and DDT-$C^{14}$. The clean-up efficiency also was equivalent to that of the Florisil columns. The availability of radioactive pesticides made it possible to study previously unexplored parameters of the fly bioassay method for the analysis of pesticide residues. Loss of DDT-$C^{14}$ from sample jars by volatilization was 10% in 24 hours at 85°F. The loss of aldrin-$C^{14}$ was much higher under the same conditions; the recoveries were less than 10%. The distribution pattern and recovery of DDT-$C^{14}$ in the fly bioassay was determined by rinsing the jar, jar cover, food plug, dead and live flies, and by combusting dead and live flies. The total recovery was 90% with about 65% of the pesticide remaining in the sample jar. Detailed results are given in the report. The presence of as little as 10 $\mu$g of food extractives per $\mu$g of pesticide was sufficient to double the $LD_{50}$ in the fly bioassay experiments. Preliminary results indicated that the effect of food extractives can be minimized by the addition of surfactants or glycols. Critical manipulations in the paper chroma-

tographic analysis of pesticides were studied using radiochemical methods. A new procedure is described for the simultaneous spotting of samples on paper prior to chromatographic separation. Using this procedure, excellent spots were formed with substantial saving of time over the conventional micropipet spotting technique. It was demonstrated (using DDT-$C^{14}$, aldrin-$C^{14}$, and dieldrin-$C^{14}$) that the new procedure accomplished an essentially quantitative transfer of pesticide from sample vial to paper. Increasing the temperature of the drying air from 122 to 158°F caused a reduction in DDT-$C^{14}$ recovery from 92% to 67%. Drying of sample spots at 122°F for 30 min gave no significant volatilization loss of DDT-$C^{14}$. Neutron activation analysis was used to obtain preliminary information on pesticide removal during processing of foods. An interesting result was found in a study of the effect of various drying conditions on the extractable "organic chlorine" in tomato pomace; no significant reduction in chlorine was accomplished by vaccum drying at 158°F or by air drying at 230°F. The "organic chlorine" found by neutron activation analysis was considerably higher (20 ppm DDT equivalent) than that found by fly bioassay or by paper chromatography. Chlorine in the juice and pomace of fresh field tomatoes (of known pesticide application history) was measured by neutron activation analysis after various washing treatments. Washing the whole tomatoes gave no significant reduction in the chlorine level in pomace from the processed tomatoes. However, a reduction in the chlorine level of the juice resulted from the washings, especially when detergents were added to the wash water. The Schoeniger flask combustion-potentiometric chloride determination procedure gave excellent pesticide recovery values when pure pesticides were used. This procedure gave values in good agreement with the neutron activation analysis results for chlorine in tomato pomace extracts. (auth)

**18334** (TID-7651) AEC SYMPOSIUM ON PACKAGING AND REGULATORY STANDARDS FOR SHIPPING RADIOACTIVE MATERIALS, [HELD IN GERMANTOWN, MARYLAND], DECEMBER 3-5, 1962. (Division of Technical Information, AEC). Dec. 1962.

A total of twenty papers and one roundtable discussion were presented. Separate abstracts were prepared for eighteen of the papers. The papers for which no abstracts were prepared are concerned with impact energy sorption by large shipping casks, design of a Pu and enriched U shipping container, and the roundtable discussion on regulatory standards. (J.R.D.)

**18335** (TID-7651(p.3-17)) TYPES AND QUANTITIES OF MATERIALS BEING SHIPPED AND AEC ACCIDENT EXPERIENCE. D. E. Patterson (Division of Operational Safety, AEC).

Analyses of experience with shipment of radioactive materials and incidents involving these shipments are presented. In a report on the analysis of shipping experience, a transfer rate for both AEC and AEC licensees was developed, however the incident summary pertains only to accidents involving AEC materials. Determination of accident frequency in this report involves comparison of on- and off-site incidents. The report which summarizes incidents involving AEC shipments provides information concerning the performance of packages under accident conditions. (J.R.D.)

**18336** (TID-7651(p.18-30)) THEORETICAL CONSEQUENCES OF ACCIDENTS. J. M. Morgan, Jr., J. W. Knapp, and J. T. Thompson (Johns Hopkins Univ., Baltimore).

An analysis concerning occurrences associated with the release or suspected release of radioactive materials during shipment is presented. The emphasis in the discussion is placed on evaluation of the economic factors associated with accidents involving radioactive cargoes. Total costs of accidents are estimated by categories. The physical consequences of accidents are also examined. (J.R.D.)

**18337** (TID-7651(p.31-44)) SAFETY CONSIDERATIONS IN THE TRANSPORTATION OF HIGHLY RADIOACTIVE MATERIALS – AN OPERATIONS RESEARCH APPROACH. Ferdinand F. Leimkuhler (Purdue Univ., Lafayette, Ind.).

Aspects of decision making in the area of radioactive materials shipment-safety are discussed. Included are discussions of decision-making under uncertainty, accident data on truck shipments, balancing safety and economy, and control policies. It is noted that as more knowledge is gained about radioactive shipment accident risks, control policies can be expected to move from a cautious minimax type of decision to a more analytic basis. (J.R.D.)

**18338** (TID-7651(p.45-54)) DEVELOPMENT OF INTERSTATE COMMERCE COMMISSION REGULATIONS. Thurber C. George (Association of American Railroads. Bureau of Explosives, New York).

In the review of regulations development, it is noted that historical information concerning these regulations is presented in Nuclear Science Series Report No. 11. Other information is given concerning the continuing changes of regulations as new materials appear, safety and personnel exposure considerations, prevention of damage to film in the shipment area, and examples of shipping permits. (J.R.D.)

**18339** (TID-7651(p.55-87)) INTERAGENCY COMMITTEE WORK ON U. S. TRANSPORTATION REGULATIONS APPLICABLE TO RADIOACTIVE MATERIALS. Lester R. Rogers (Division of Licensing and Regulation, AEC).

A review of work on revisions to Federal transportation regulations applicable to radioactive materials is presented. Background information concerning the interagency work committee and the regulations now in force is included. Other information is given concerning the objectives of the revision and proposed changes. Radioactive shipment categories and regulation comparisons are presented tabularly. (J.R.D.)

**18340** (TID-7651(p.88-98)) U. S. ATOMIC ENERGY COMMISSION REGULATIONS PERTAINING TO FISSILE MATERIALS. Robert F. Barker (Division of Licensing and Regulation, AEC).

A review of proposed regulations 10CFR71 and 72 is presented. These regulations are concerned with precautions associated with shipment of special nuclear or fissile materials, and the general criteria for design of shipping containers. It is noted that nuclear safety of shipment methods must be supported by experimental data, calculations, or plans for special controls. Aspects related to the choice of conditions to be assumed in applying the safety criteria are discussed. Specifications for shipping containers are also discussed from the standpoint of ruggedness, criticality, and shielding. (J.R.D.)

**18341** (TID-7651(p.99-102)) DEVELOPMENT OF TRANSPORTATION REGULATIONS IN CANADA. W. A. Martin (Canada. Board of Transport Commissioners).

A review of regulations now in effect in Canada concerning transport of radioactive materials is presented along with comment concerning development and implementation

of these regulations. A committee formed in 1961 by government representatives interested in safe transportation of radioactive materials accepted the general criteria in pamphlet No. 6 and 7 of the International Atomic Energy Agency as basis for drafting uniform regulations. Recommendations for revisions in the pamphlets are listed. (J.R.D.)

**18342** (TID-7651(p.103-25)) DEVELOPMENT OF TRANSPORT REGULATIONS IN THE UNITED KINGDOM. Roy Gibson and W. de L. M. Messenger (United Kingdom Atomic Energy Authority. Authority Health and Safety Branch, Risley, Lancs, England).

A review and discussion of regulation development is presented in sections on early U. K. regulations, U. K. policy, International Atomic Energy Agency (I.A.E.A.) regulations, and present U. K. regulations. Other information is included on packaging, accidents, approved packaging designs, and future developments. A comparison of regulations in the U. K. Blue Book and the I.A.E.A. transport regulations is included. (J.R.D.)

**18343** (TID-7651(p.126-31)) METHODS AND PROBLEMS IN EVALUATING APPROVING CASKS USING SAFETY STANDARDS. Alexander E. Aikens, Jr. (Division of Licensing and Regulation, AEC).

It is noted that results of evaluations of various shipping cask designs indicate that it is difficult to show conformance with several criteria contained in A.E.C. CFR72 (proposed) because of a lack of sufficient data or lack of adequate analytical techniques. Some of the criteria against which it has been consistently difficult to assess cask design are discussed. The criteria considered include those which require data from major testing to permit better analysis, those which could be determined by relatively simple experiments, and those requiring proof conformance by performance testing. (J.R.D.)

**18344** (TID-7651(p.132-44)) PROBLEMS IN DESIGNING CASKS TO MEET REGULATORY STANDARDS. John W. Langhaar (Du Pont de Nemours (E. I.) & Co. Atomic Energy Div., Wilmington, Del.).

It is noted that an important function of the cask designer is to produce the most economical design which is acceptable. Data-based methods of predicting fuel and cask behavior are required for design procedures in which cost is minimized and regulations are complied with. For several requirements of the regulations set forth in AEC CFR Part 72, engineering knowledge is inadequate at present. Discussions are presented in which the most troublesome paragraphs in this regulation are considered singly. (J.R.D.)

**18345** (TID-7651(p.145-60)) TEST OF FISSILE MATERIAL SHIPPING CONTAINERS. James M. Hoffmann (Du Pont de Nemours (E. I.) & Co., Wilmington, Del.).

An investigation was made of the shipping container "bird cage" used for Pu button shipments to assess what may happen to it in a railroad accident. It was found that in a rapid deceleration from 30 mph the cage would suffer severe permanent distortion, but would remain intact. (auth)

**18346** (TID-7651(p.161-86)) TESTS OF A PROPOSED URANIUM CONTAINER. J. D. McLendon (Union Carbide Nuclear Co. Y-12 Plant, Oak Ridge, Tenn.).

A simple, relatively cheap shipping container, available from many potential suppliers, was designed and tested for impact and fire resistance. Although tests were limited, results meet, or exceed, specifications of proposed standards. In view of favorable fire and impact resistance, and considering mechanical and geometric design, it is concluded that nuclear safety of enriched U shipments in these containers would be at least as good as that experienced with Y-12 birdcages. The container currently meets Class II, IAEA requirements. With some modifications it is conceivable that Class I specifications can be met. (auth)

**18347** (TID-7651(p.197-210)) STATIC AND IMPACT TESTS ON A FULL-SCALE, IRRADIATED FUEL SHIPPING CASK. Wayne I. Thisell (Du Pont de Nemours (E. I.) & Co., Wilmington, Del.).

A 15-ton, lead-shielded steel cask used for rail shipment of irradiated fuel was subjected to static and impact tests. The tests are described and results are summarized. (auth)

**18348** (TID-7651(p.211-37)) THE CASK TESTING PROGRAM AT THE OAK RIDGE NATIONAL LABORATORY. L. B. Shappert (Oak Ridge National Lab., Tenn.).

A program to determine how safe unbuffered, Pb-filled shipping casks are with respect to structural integrity is described. Accident conditions considered include those in which casks strike unyielding objects or are impaled. Results indicate that steel-shelled Pb-filled casks meet impact requirements, however it appears that the puncture test could not be met. Another test, thought to be realistic, to replace the puncture test is proposed in which the cask is dropped on a 1-ft-wide unyielding beam. (J.R.D.)

**18349** (TID-7651(p.238-64)) MODEL IMPACT TESTS PERTAINING TO SHIPPING CONTAINERS FOR RADIOACTIVE MATERIALS. H. G. Clarke, Jr., and W. E. Onderko (Franklin Inst., Philadelphia).

Activities in a program to develop quantitative methods for assessing the structural integrity of shipping containers for radioactive materials are reported. Models were used in impact tests which led to the conclusion that such investigations can reveal qualitatively those configurations, materials and fabrication techniques which increase integrity. Test data are included. (J.R.D.)

**18350** (TID-7651(p.304-14)) FIRE TESTING OF RADIOISOTOPE SHIPPING CONTAINERS AND COBALT 60 TELETHERAPY HEAD. Leonard Horn (Underwriters' Labs., Inc., Chicago).

Standard 1-hr fire tests in which 1000°F is reached after 5 min from start, 1300 after 10 min, 1550 after 30 min, and 1700 after 1 hr were performed on a type 2 R radioactive shipping container, a type 55 radioactive shipping container, and a $Co^{60}$ teletherapy head. Only the type 2R container, constructed of stainless steel, withstood the test. The other two items lost shielding or cracked. Data and discussion concerning the tests are included. (J.R.D.)

**18351** (TID-7651(p.315-30)) A PROPOSED STUDY OF RAIL AND HIGHWAY TRANSPORT SYSTEMS DURING A CREDIBLE ACCIDENT. Robert Meldrum (Office of the Chief of Transportation, Washington, D. C.).

Proposals for study concerned with the magnitude, orientation, and distribution of shock forces during rail and highway accidents are discussed. The study would be conducted to provide a basis for establishing standards, designs and procedures that will assure maximum practical safety at minimum cost in the transport of radioactive materials. (J.R.D.)

**18352** (TID-7651(p.331-93)) THE DESIGN OF SHIELDED CONTAINERS TO I.A.E.A. STANDARDS. F. E. Dixon (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). (TCAP/P.64)

Problems encountered in design of lead shielded containers to the standards of the International Atomic Energy Agency are discussed. The effects of heat on Pb-filled containers and protection methods to prevent heat and mechanical damage are also discussed. Test programs are described. (J.R.D.)

**18353** (TID-7652) SYMPOSIUM ON PROTECTION AGAINST RADIATION HAZARDS IN SPACE, HELD IN GATLINBURG, TENNESSEE, NOVEMBER 5-7, 1962. (Oak Ridge National Lab., Tenn.; National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.; and American Nuclear Society, Hinsdale, Ill.). 898p.

Forty-five papers are presented in two books; one paper was not received in time for inclusion. Book 1 deals with the nature of cosmic radiation and with studies of radiation effects on animals, materials, and men. Book 2 deals with shielding requirements for space flight, radiation doses from various sources, and types of shielding. Abstracts were prepared for thirty-nine papers. Six papers were previously abstracted. (D.C.W.)

**18354** (TID-7652(p.vii-xvii)) THE MISSION OF MAN IN SPACE. Homer E. Newell (National Aeronautics and Space Administration, Washington, D. C.).

The nature and purpose of man's exploration of space are reviewed to show the need for developing radiation shielding that would permit space travel. (D.C.W.)

**18355** (TID-7652(p.1-11)) BRIEF NOTE ON THE RADIATION BELTS OF THE EARTH. J. A. Van Allen (Iowa. State Univ., Iowa City).

Information on the intensity distributions of electrons and protons of various energies in the Van Allen belts is summarized. (D.C.W.)

**18356** (TID-7652(p.12-32)) AN EVALUATION OF THE RADIATION HAZARD DUE TO SOLAR COSMIC RAYS. W. R. Webber and P. S. Freier (Minnesota. Univ., Minneapolis).

The nature of hazards in space from cosmic radiation due to solar flares is examined. Aspects of studying cosmic ray events from solar flares are explained. Data on major cosmic ray outbursts from 1956 to 1961 are presented. Analysis reveals that the flares most likely to produce cosmic rays observable at earth arise in the sun's western hemisphere. A correlation between the flare's position on the sun and the times characterizing the events intensity-time profile is also noted. Evaluation of the free space or total skin dose for each event shows that only the few largest events present serious radiation shielding problems. An average of one region of solar activity producing one or more major cosmic ray events appears each year. The frequency of dangerous cosmic ray outbursts may be greater during periods of decreasing or increasing solar activity. (D.C.W.)

**18357** (TID-7652(p.33-43)) COMPOSITION OF SOLAR COSMIC RAYS. C. E. Fichtel (National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.).

Relative abundances of helium nuclei, heavier nuclei, electrons, and $\gamma$ rays in solar cosmic radiation are examined. Energy and rigidity spectra for the protons, He nuclei, and heavier nuclei are presented, and values obtained by several researchers for the proton to He ratio are given. Among the heavier nuclei, the medium nuclei are the most abundant, but only one-sixtieth as abundant as He (second only to protons in abundance). Scanty information on electron and $\gamma$ abundances is available. For one event, high-energy electron flux of only a few percent of the proton flux in the same kinetic energy region was observed. Two events for which $\gamma$ fluxes of the order of $10^7$ ev/cm$^2$-sec were estimated are reported, but for several large solar flares no $\gamma$ rays were detected. (D.C.W.)

**18358** (TID-7652(p.44-85)) DETAILS OF INDIVIDUAL SOLAR PARTICLE EVENTS. Carl E. Fichtel, Donald E. Guss, and K. W. Ogilvie (National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.).

An attempt is made to present a time history of the energies and intensities of solar cosmic particles detected at or near the earth. Description of the riometers, neutron monitors, and direct primary particle detectors used in the studies precedes discussion of the individual events. Diagrams giving the integral flux as a function of time above specified energies are presented. Energy spectra at various times during the event are also included. 76 references. (D.C.W.)

**18359** (TID-7652(p.86-7)) INFORMATION ON SOLAR PROTON EVENTS (PCA'S) DEDUCED FROM RADIO OBSERVATIONS. D. K. Bailey (National Bureau of Standards, Boulder, Colo.).

Use of radio techniques to make continuous studies of polar-cap absorption events is discussed, and problems met in determining the radiation hazard posed by solar-events from such observations are considered. (D.C.W.)

**18360** (TID-7652(p.88-95)) STATISTICAL PREDICTION OF SOLAR PROTON EVENTS. James B. Weddell (North American Aviation, Inc., Downey, Calif.).

A method of correlating solar flares in time with several indices of activity of solar regions is described. The method determines the probability of occurrence of a flare if each of two indices exceeded given limits, and the average time between measurement of these indices and the outbreak of the flare. Significant correlations are listed; the most important is the tendency for major flares to occur in the second passage across the solar disk of regions exceeding 2000 millionths of the solar hemisphere in area, and which give rise to small flares during their first passage. These criteria permit prediction of 69% of class 3 flares at least 14 days in advance. Flare positions have been correlated with the magnetic field in active regions. The field near the sites of flares tends to be frozen into the solar atmosphere to a greater extent than other portions of the field. (auth)

**18361** (TID-7652(p.96-117)) COMMENTS ON THE PRODUCTION OF SOLAR HIGH ENERGY PARTICLES. M. C. Chapman, R. E. Fortney, and M. R. Morrison (Northrop Corp. Northrop Space Labs., Hawthorne, Calif.).

A general qualitative model for the production of solar high-energy particles (SHEP) that can explain several observed flare phenomena is used in the analysis of a specific flare event. The model, incorporating the work of several Russians and Americans, explains the occurrence of solar radio emission, the initial anisotropic and later isotropic distribution of flare particles, Forbush decreases in cosmic ray intensity, decreases in cosmic radio noise, and fluctuations in the earth's magnetic field due to solar flare particles. Also qualitatively explained are such phenomena as the occurrence of shock waves during flare events, observed surges in the active region, and movement of magnetic "bumps" before the start of the flare. (auth)

**18362** (TID-7652(p.118-35)) RADIATION DAMAGE TO SOLAR CELLS. J. A. Baicker and P. Rappaport (Radio Corp. of America. RCA Labs., Princeton, N. J.).

The construction, operation, and performance characteristics of solar cells are described. The radiation damage process is discussed, and details of proton and electron damage to silicon cells presented. The degradation of the photovoltaic current-voltage characteristics and the spectral response are shown, and a comparison made of various types of solar cells, including silicon, gallium arsenide and cadmium sulfide. Differences between p/n and n/p silicon cells are discussed and explained in terms of basic properties of the radiation defects. (auth)

**18363** (TID-7652(p.136-200)) SURFACE EFFECTS OF RADIATION ON TRANSISTORS. D. S. Peck, R. R. Blair, W. L. Brown, and F. M. Smits (Bell Telephone Labs., Inc., Murray Hill, N. J.).

Changes that occur in semiconductor devices due to surface effects of ionization are examined. A discussion of bulk radiation effects precedes an examination of surface effects and the formulation of a model for the effects. Comparisons of the model with the characteristics of effects in a significant number of devices are included. Selection and testing of Telstar devices are also described. (D.C.W.)

**18364** (TID-7652(p.201-20)) NASA SPACE RADIATION EFFECTS LABORATORY. John Duberg and Emanuel Rind (National Aeronautics and Space Administration. Langley Research Center, Langley Station, Hampton, Va.).

Space particulate radiation from the Van Allen belts and from cosmic and manmade sources has energies and fluxes that have produced and are capable of producing damage in matter and living organisms that comprise space mission payloads. A ground based Space Radiation Effects Laboratory that simulates most of the particulate energy spectrum found in space and can be used in an effective, accelerated, radiation research program by means of which deleterious radiation effects can be minimized or eliminated is proposed. To achieve these results in a minimum time, a 600-Mev proton, synchrocyclotron of proven design with variable energy and variable external beam size, as well as a 1 to 30 Mev electron accelerator with the same capabilities have been incorporated into the proposed facility. Although these devices will be used as engineering tools, provision has been made to maintain the basic research capabilities of these accelerators. The proposed Space Radiation Effects Laboratory will provide the necessary facilities for conducting an expanding radiation effects research program using particulate radiation that simulates the space spectrum. (auth)

**18365** (TID-7652(p.220-9)) THE EFFECTS OF PROTONS ON SEMICONDUCTOR DEVICES. William C. Honaker (National Aeronautics and Space Administration. Langley Research Center, Langley Station, Hampton, Va.).

Experimental results are presented covering the data obtained from the bombardment of several transistors with 40 and 440 Mev protons. The data indicated a proton energy as well as a transistor frequency dependence on degradation. Figures are presented showing relative degradation of transistors with integrated flux. (auth)

**18366** (TID-7652(p.230-42)) PROTON RADIATION DAMAGE IN SEMICONDUCTOR DEVICES. D. A. Gandolfo, D. M. Arnold, J. R. Parker, J. Vollmer (Radio Corp. of America, Camden, N. J.); J. A. Baicker, H. Flicker, and J. Vilms (David Sarnoff Research Center, Princeton, N. J.).

Observed changes in transistor electrical characteristics are interpreted in terms of fundamental damage in the semiconductor crystal structure to predict the effects of proton bombardment. Proton and neutron displacement production rates are calculated. These are used in conjunction with neutron irradiation data and an assumed similarity of defect clusters to determine the effects of protons on transistors. Reasonable agreement with experiment is obtained. The expected lives of transistors in satellites orbiting in the inner Van Allen belt are given. (auth)

**18367** (TID-7652(p.243-59)) SOLAR CELL DEGRADATION BY PROTONS IN SPACE. Richard Madey (Republic Aviation Corp., Farmingdale, N. Y.).

An analytic expression for the decrease in efficiency of a solar cell behind a protective cover glass exposed to a spectral distribution of protons is formulated on the basis that the time rate of decrease in output power is proportional to the proton dose rate absorbed at the surface of the solar cell. The decrease in the maximum power output $\Delta P$ of a solar cell exposed to protons in space is found to be $\Delta P = \frac{1}{2} P_0 \ln (1 + \bar{\tau} L_i^2 D)$, where D is the absorbed dose of protons at the surface of the solar cell behind a protective cover glass, and $L_i$ is the initial value of the diffusion length of the minority carriers of the solar cell corresponding to the initial maximum power output $P_i$. The quantity $\bar{\tau}$ is a radiation damage factor averaged over the absorbed dose rate from a spectral distribution of protons. The decrease in the maximum power output of an n-on-p silicon solar cell exposed to the solar flare of November 12, 1960, is calculated as a function of the thickness of protective cover glass for a power-law representation of the differential flux spectrum of the incident protons. (auth)

**18368** (TID-7652(p.260-8)) EFFECT OF ELECTRON IRRADIATION ON THE MECHANICAL PROPERTIES OF A COMPOSITE FOIL FOR INFLATABLE SATELLITES. Thomas G. James (National Aeronautics and Space Administration. Langley Research Center, Langley Station, Hampton, Va.).

The effects of electron radiation on the mechanical properties of ECHO II material were studied. The primary effect of electron irradiation on the Echo II skin material is an increased brittleness that leads to an early and brittle failure in both the burst strength and ultimate strength tests. Severe surface damage, which occurs at doses on the order of $10^{17}$ e/cm$^2$, causes mechanical damage to the aluminum foil portion of the skin and may lead to changes in the temperature control characteristics of the surface. (auth)

**18369** (TID-7652(p.269-74)) ACUTE EFFECTS OF RADIATION EXPOSURE IN MAN. J. J. Nickson (Memorial Hospital, New York and Sloan-Kettering Inst. for Cancer Research, New York).

Data on the effects of exposure of men to radiation for medical purposes, in nuclear accidents, and from nuclear weapons are discussed. An acute syndrome that can be divided into events associated with effects upon the function of the marrow, upon the epithelium or the gastrointestinal tract, upon the skin, and upon the central nervous system is noted. Abnormalities from which recovery may occur are emphasized, and an attempt is made to relate dose time considerations to the kinds of effects seen. (auth)

**18370** (TID-7652(p.275-90)) LATE EFFECTS IN MAN FOLLOWING EXPOSURE TO IONIZING RADIATIONS. Douglas Grahn (Argonne National Lab., Ill.). (TID-17606; UAC-7000)

Information from criticality accident studies, the nuclear explosions in Japan, and from irradiations of small

animals is analyzed in a study of the late (genetic and somatic) effects of man's exposure to radiation. An attempt to develop a workable relation between life expectancy and exposure is reported, and the incidence of various disorders (leukemia, etc.) after exposure is examined. Sterility and mutational phenomena are also considered. Assessment of hazards in space flight is briefly discussed. (D.C.W.)

**18371** (TID-7652(p.309-42)) BIOLOGICAL EFFECTS OF HIGH ENERGY PROTONS. C. A. Sondhaus (California. Univ., Berkeley. Donner Lab.).

Data on the biological effects of high-energy proton irradiations of animals in space and in proton facilities are presented and discussed. Experimental work now under way is summarized, and medical cave modifications at the 184-inch cyclotron to permit further experiments are reported. (D.C.W.)

**18372** (TID-7652(p.343-74)) EFFECTS OF ACUTE RADIATION EXPOSURE ON HUMAN PERFORMANCE. R. B. Payne (School of Aerospace Medicine, Brooks AFB, Tex.).

Two studies of the effects of acute radiation exposure on the performance of human beings are described. In one test the subjects were treated with equivalent whole-body doses either in single or in multiple exposures. Analysis of the data gave some evidences that the single exposures attenuated habit acquisition more than the multiple exposures. The other study involved higher single dose exposures. No distinct evidence for effects on the variables measured was noted. Supplementary tests on monkeys showed no effects on performance, but a tendency for the animals to become less responsive to peripheral stimuli was observed. The acute radiation syndrome is apparently the main factor in the specification of permissible acute exposure levels. 55 references. (D.C.W.)

**18373** (TID-7652(p.375-92)) THE LETHAL EFFECTIVENESS OF A SOLAR FLARE-TYPE DOSE DISTRIBUTION DELIVERED TO THE RAT. K. L. Jackson (Boeing Co., Seattle).

An investigation of some biological effects produced by exposure of rats to a solar flare-type depth-dose distribution was carried out. Space proton doses to bone marrow will not be appreciably attenuated by surrounding bone and in the present study, this was simulated by use of cobalt-60 gamma radiation. Depth-dose distribution, produced in rats by a filter-rotation technique, resulted in a midline dose which was 25 per cent of the surface dose. This depth-dose is similar to that calculated for exposure of man to July 16, 1959 solar flare protons with 10 gm/cm$^2$ of shielding. The 50 per cent lethal dose ($LD_{50}$) measured at the surface of the rat was three times greater for depth-dose exposure as compared to uniform exposure. The midline $LD_{50}$ was less for depth-dose exposure than for uniform exposure. The depth in the body at which the depth-dose $LD_{50}$ was equal to the uniform $LD_{50}$ was approximately 50 per cent of the distance from the surface to the midline. The total energy absorbed at the $LD_{50}$ was 1.5 times greater with depth-dose exposure as compared to uniform exposure. Mean survival time of decedents in the $LD_{16}$–$LD_{84}$ range was significantly shorter in depth-dose exposed animals as compared to uniformly exposed animals. This suggests that depth-dose exposure produces greater injury to the intestine which was verified by measurement of intestinal weight changes. (26 references). (auth)

**18374** (TID-7652(p.393-401)) LET SPECTRUM AND RBE OF HIGH ENERGY PROTONS. Hermann J. Schaefer (Naval School of Aviation Medicine, Pensacola, Fla.).

High intensity proton radiations in space temporarily superimposed upon the ordinary cosmic ray beam have energy spectra extending from a few to many hundred Mev. Analysis of the LET spectrum of a typical flare produced proton beam shows that the bulk of the energy dissipation is effected with an LET spectrum closely resembling that of standard x-rays. A basic difference exists in the spectral region beyond 10 kev/micron tissue. Though the fractional dose in that region expressed in rad remains on the level of a few per cent, it represents a significant though not a major part of the total rem dose. It is suggested that both dose fractions be treated separately in assessing the ERD (Equivalent Residual Dose) with the recovery allowance of 2.5 per cent per day applicable only to the low LET fraction. (auth)

**18375** (TID-7652(p.402-8)) SOME DATA ON THE RELATIONSHIP OF RBE AND LET. W. S. Snyder (Oak Ridge National Lab., Tenn.).

The RBE of one radiation with respect to a standard radiation is usually defined as the inverse ratio of doses required to produce the same degree of a specified biological effect. It is well known that the RBE depends not only upon the quality of the radiations but also upon such conditions of exposure as dose rate, fractionation of dose, strain and condition of animals, and the biological effect studied. Some experimental data are analyzed to obtain an indication of the dependence of RBE on LET. The cases considered include some experimental studies of effects on cells and on mice. The interpretation of such data for certain conditions of exposure in space is discussed in a preliminary way. (auth)

**18376** (TID-7652(p.409-32)) MEASUREMENTS OF SECONDARY SPECTRA FROM HIGH-ENERGY NUCLEAR REACTIONS. Karl Strauch (Harvard Univ., Boston).

The mechanism of the interaction of a high energy nucleon with a complex nucleus is discussed, and the various types of reaction are described. The available experimental data on secondary particles are summarized, emphasis being placed on those secondaries that might be important for shielding considerations. 33 references. (auth)

**18377** (TID-7652(p.523-94)) EXPERIMENTAL TECHNIQUES FOR THE MEASUREMENT OF NUCLEAR SECONDARIES FROM THE INTERACTIONS OF PROTONS OF A FEW HUNDRED Mev. F. C. Maienschein, T. V. Blosser, H. R. Brashear, et al. (Oak Ridge National Lab., Tenn.).

The preparations for a set of experiments designed to check space shielding calculations are described. The experiments are at an early stage and all information must be considered as preliminary. The approximate calculations of Alsmiller were used to estimate that spectral measurements are most important for secondary neutrons, protons, and gamma rays arising from the interactions of incident protons in the energy range from 20 to 600 Mev. Both thin and thick targets are needed to check the two pertinent types of calculations, those for the prediction of cross sections and secondary spectra for intranuclear cascades and those for transport through shields. Previous measurements exist only for thin targets and these are all limited in energy resolution or the range of energies and angles covered. For the present experiments, the choice of spectrometers was conditioned by the need to move the equipment to several accelerators and the very stringent time schedule imposed by the need for shielding information for the Apollo mission to the moon. Thus, for neutron spectroscopy magnetic-deflection of proton recoils was not seriously considered. Three approaches have been

followed with extensive development. Proton-recoil telescopes of two types have been studied, but current emphasis centers on a dE/dx scintillation spectrometer for the energy range above 50 Mev. Neutron time of flight over a short path is being utilized to cover the energy range from a few Mev to ~50 Mev with reasonable resolution. Finally, a set of Bonner spheres is used for the energy range below 10 Mev. 27 references. (auth)

**18378** (TID-7652(p.595-607)) SECONDARY-PARTICLE DOSE CONTRIBUTIONS INDUCED BY SOLAR PROTON RADIATION. R. K. Wilson and R. A. Miller (General Dynamics/Fort Worth. Div. of General Dynamics Corp., Fort Worth, Tex.).

A study was made to determine the biological hazard due to secondary radiation components produced in bulk shielding by high-energy extra-terrestrial protons. An idealized shield system — spherical-shell shield with a differential-volume water-target at the center — was chosen for the study. A comparison was made of the physical dose due to primary protons penetrating the shield and the secondaries produced in the shield. It was found that shield-target geometry and target model greatly influence the ratio of primary proton-to-secondary component dose, and that secondaries may well be important for shield thicknesses greater than about 10 gm/cm$^2$ in the case of an aluminum shield and a solar-flare proton spectrum. (auth)

**18379** (TID-7652(p.608-18)) A SERIES OF MONTE CARLO CODES TO TRANSPORT NUCLEONS THROUGH MATTER. W. E. Kinney, R. R. Coveyou, and C. D. Zerby (Oak Ridge National Lab., Tenn.).

A series of Monte Carlo codes for the IBM-7090 computer has been written to transport nucleons of energy less than 400 Mev through complex configurations composed of four or fewer materials. The nucleons above 50 Mev are treated by a high-energy transport code that uses an intra-nuclear cascade subroutine to compute the production of secondary nucleons. Below 50 Mev, protons are allowed to proceed straight ahead with no nuclear interactions, and neutrons are transported by the already existing 05R code. Doses in tissue behind aluminum slabs of varying thickness estimated from 1940 400-Mev source protons and their descendants showed the primary beam dose to be more than a factor of two larger than the dose due to all secondaries. (auth)

**18380** (TID-7652(p.619-32)) THE CALCULATION OF RADIATION DOSE IN TISSUE FROM HIGH-ENERGY PROTONS. J. E. Turner, J. L. Feuerbacher, C. D. Zerby, W. E. Kinney, J. Neufeld, W. S. Snyder, and R. L. Woodyard (Oak Ridge National Lab., Tenn.).

Monte-Carlo calculations are being developed for the paths and interactions of particles of various kinds and energies and for secondary particles they produce when incident on phantoms of a given composition, i.e., for materials and combinations of materials of given atomic number Z and mass number A. These calculations provide histories of the particles involved, as described in the preceding paper. For the estimation of dose from high-energy radiation, particle histories were analyzed in a tissue slab of thickness 30 cm from normally incident protons with energies of 100, 150, 200, 250, 300, 350, and 400 Mev. Calculations at still higher energies are in progress. The results of the calculation of rad and rem dose as a function of depth in the tissue slab are presented. Also shown at each incident energy is the relative contribution of recoil nuclei (and other particles with mass number A > 1) to the total absorbed energy per unit mass. For the purpose of estimating rem dose, the recommendations of the National Committee on Radiation Protection and Measurements (NCRP) published in NBS Handbook 59 were used. For values of linear energy transfer (LET) greater than those considered in Handbook 59 (viz., for LET > 1750 Mev/cm) an RBE (relative biological effectiveness) value of 20 was used. A method for analyzing particle histories is utilized that will later permit computations of rem dose curves under very general assumptions about the dependence of RBE on LET. The rem dose as presented here uses the estimation of LET as formulated by Neufeld and Snyder and is calculated using their methods. (auth)

**18381** (TID-7652(p.633-61)) SPACE PROTON DOSES AT POINTS WITHIN THE HUMAN BODY. David L. Dye (Boeing Co. [Aero-Space Div.], Seattle).

Distribution patterns of absorbed dose influence the radiation response of a mammalian system, because of differing radiosensitivities of different organ systems. In a man exposed to space radiations; e.g., an astronaut, body self-shielding produces nonuniform dose distributions that depend upon external shielding configurations and the incident radiation parameters. The doses at twelve specific points in the body of a seated man exposed to isotropic incident space protons, where the man is inside various thicknesses of external vehicle shell shielding are presented. The body points, selected for their radiobiological interest, are in (or on) sternum, chest skin, femur, spinal column, eye, central gut, and a series at various lateral depths on the waist. The protons reaching these specific points from all directions traverse tissue thicknesses that were determined from scale drawings of a statistically standard man (75-percentile). The proton penetration, secondary radiation generation, and total dose delivered to each specific body point were calculated using an IBM (Fortran) computer code. (auth)

**18382** (TID-7652(p.662-81)) LONG RANGE NASA SHIELDING REQUIREMENTS. J. Warren Keller (National Aeronautics and Space Administration, Washington, D. C.).

The NASA being confronted with the relatively short range problem of shielding for Project Apollo is faced with the task of developing a shielding technology applicable not only to Apollo but to future manned or unmanned missions as well. Future missions will present in many cases much more severe shielding problems than those encountered in Apollo, primarily because of their longer duration in affected regions in space. Several types of future missions are discussed in a quite general manner to establish the magnitude of the shielding problems that may exist. Also, some of the uncertainties in environmental data and shielding calculations are discussed in an effort to clear up some misconceptions which exist as to the need for a significant shielding effort with respect to future missions. The available on-board mass in the form of equipment, fuel, etc., must obviously be utilized as shielding where possible. However, high effectiveness in the utilization of such mass may be difficult. The importance of accurate determination of such effectiveness is pointed out. An effort is made to outline a general approach to the space vehicle shielding problem. (auth)

**18383** (TID-7652(p.682-97)) COMPARISON OF MONTE CARLO AND IONIZATION CALCULATIONS FOR SPACECRAFT SHIELDING. K. A. More and O. L. Tiffany (Bendix Corp. Bendix Systems Div., Ann Arbor, Mich.).

Various methods used to calculate shield designs for manned space vehicles differ in the approximations used to describe the spacecraft geometry and the physical in-

teractions of the space particles in the vehicle shield. Since calculation time is least for the methods with the most approximations, it is desirable to know what degree of approximation is permissible in designing shields. The results of shield calculations using the Monte Carlo method and the more approximate ionization loss method are compared. Thick shields are required on long-term missions during which a large number of nuclear collisions will occur. The contribution to the astronaut's dose from the nuclear collision particles, especially the contribution from secondary neutrons, cannot be neglected. Consequently, there is a critical thickness in shield design at which shielding calculations must account for nuclear collisions. To find this thickness, calculations were performed on a spherical shell aluminum spacecraft. The Monte Carlo code was basically the same one used in previous calculations, there being added a subroutine for nuclear evaporation. The nuclear evaporation subroutine was patterned after the evaporation model used by Allen. The ionization loss calculation was taken directly from that part of the Monte Carlo program that computes ionization loss. Since the Monte Carlo calculation used the multigroup energy approximation, the ionization loss calculation also includes the multigroup approximation. While this method decreases the accuracy of an ionization loss calculation, its use here permits more direct comparison. (auth)

**18384** (TID-7652(p.698-712)) NUCLEON-MESON CASCADE CALCULATIONS IN THE STRAIGHT-AHEAD APPROXIMATION. R. G. Alsmiller, Jr., F. S. Alsmiller, and J. E. Murphy (Oak Ridge National Lab., Tenn.).

Nucleon-meson cascade calculations were made for monoenergetic proton beams incident on aluminum shields. The results are used to obtain information for shielding against a solar flare proton spectrum. A comparison between the one-dimensional cascade calculations and the more rigorous Monte Carlo calculations has been made. The two calculations are in approximate agreement. An IBM-7090 code that is being written to solve the nucleon-meson cascade equations is described. (auth)

**18385** (TID-7652(p.725-38)) PROTON FLUXES ALONG TRAJECTORIES THROUGH THE INNER VAN ALLEN BELT. F. C. Perry (Boeing Co. Aero-Space Div., Seattle).

A method is formulated to calculate, by means of high-speed digital computing equipment, the total time-integrated proton flux for an arbitrary trajectory through the inner Van Allen belt. To this end, a map of the inner belt proton flux has been prepared in the (B,L) coordinate system, where B is computed from the 48-term spherical harmonic expansion of the earth's magnetic potential due to Finch and Leaton and L is the McIlwain parameter. This map is feasible, since the high-energy trapped proton component is generally quite stable with respect to geomagnetic activity. The major sources of error inherent to the proton map in the (B,L) coordinate system are not to be found in the mathematical description of the geomagnetic field, but rather are to be found in positional inaccuracies of raw counting rate data, ambiguities connected with discrimination between protons and electrons, and time variations in the low energy proton component. This is especially true for large values of L ($L > 1.6$). Of interest are the marked differences between these proton flux contours and the proton flux contours calculated from the neutron albedo hypothesis. Such differences indicate that other source mechanisms may well be important for populating the inner belt. (auth)

**18386** (TID-7652(p.739-59)) A CALCULATIONAL PROCEDURE FOR ESTIMATING SPACE RADIATION EXPOSURE DURING LUNAR MISSIONS. R. A. Miller and W. Cranford (General Dynamics/Fort Worth. Div. of General Dynamics Corp., Fort Worth, Tex.).

One problem concerned with manned space missions is the determination of shielding requirements for the protection of man from the hazards of space radiation. A space trajectory radiation exposure procedure (STREP) has been developed to estimate the magnitude of this radiation hazard by calculating the time-integrated spectra incident on a vehicle on a simulated trajectory during missions in cislunar space. STREP will calculate the dose received from radiation penetrating a thin shield. A brief description is given for the trajectory and radiation computational techniques. Some results are given for calculations of the integrated spectra and dose incident on a vehicle subjected to trapped radiation, cosmic radiation, and solar flare radiation during a lunar mission of about seven days. (auth)

**18387** (TID-7652(p.760-72)) RADIATION DOSAGES FROM ELECTRONS AND BREMSSTRAHLUNG IN THE VAN ALLEN BELTS. S. L. Russak (Martin-Marietta Corp. Aerospace Div., Baltimore).

Radiation dose rates were calculated for six electron spectra. The decrease in dose rate with shielding was determined—and in each case the electron dose becomes insignificant with 2 to 6 $gm/cm^2$ of aluminum. Electron bremsstrahlung dose rates versus absorber thickness were also calculated. Detailed dosage calculations for an Apollo-type spacecraft were made and mission dosages for four lunar trajectories are given, to show the effects of trajectory selection. These are compared with the dosages from protons and secondary neutrons in the Van Allen Belt. Doses as a function of orbital altitude, of inclination and of absorber thickness are also presented for the latest version of the inner belt. (auth)

**18388** (TID-7652(p.773-93)) SYNTHESIS OF MINIMUM WEIGHT PROTON SHIELDS. A. D. Krumbein, P. S. Mittelman, E. S. Troubetzkoy, F. Nakache, and J. Celnik (United Nuclear Corp. Development Div., White Plains, N. Y.).

A shield optimization technique originally developed for reactor shields was applied to proton shields. The cases of both spherical and nonspherical shields were studied, and the effects of certain special constraints and of secondary neutrons were included in the analysis. The method indicates which materials should go into making up the minimum weight shield and what their order and the thickness of each material should be. The amount of weight saved is found to be a function of the radius of the shielded void and of the specified attenuation required. (auth)

**18389** (TID-7652(p.808-18)) SHIELDING OF SPACE VEHICLES BY MAGNETIC FIELDS. N. Edmonson, C. D. Verwers, and F. L. Gibbons (General Dynamics/Fort Worth. Div. of General Dynamics Corp., Fort Worth, Tex.).

Shielding the vehicle from charged particles by the use of magnetic fields is an obvious possibility. The feasibility of this type of shielding was reported by R. H. Levy, who utilized the properties of new superconducting materials. A program was initiated to study various aspects of magnetic shielding of space vehicles. In one phase of the program, a procedure was formulated and coded for the IBM-7090 computer for rapidly computing the field of an optimized superconducting solenoid. In another phase,

samples of NbZr wire were irradiated with neutral particles from two sources. Preliminary results are now available. Irradiation with $10^{11}$ neutrons per $cm^2$ from the D-T reaction showed no change in the critical current versus magnetic field curve. Irradiation with $10^{16}$ neutrons (> 2.9 Mev) per $cm^2$ showed a slight downward shift in the critical current. It is difficult to say whether this shift was due to the irradiation or due to the environment during the irradiation. (auth)

**18390** (TID-7652(p.819-28)) THE COMBINATION OF ACTIVE AND PASSIVE SHIELDING. J. M. Norwood (General Dynamics/Fort Worth. Div. of General Dynamics Corp., Fort Worth, Tex.).

Improved shielding of space vehicles against high-energy charged-particle radiation can conceivably be obtained by combining active and passive shielding. Methods of shielding calculations and some preliminary observations pertaining to active-passive shielding are given. An analysis based upon the field of a magnetic dipole indicates that weight savings in bulk shielding can be accomplished. (auth)

**18391** (TID-7652(p.852-65)) SOME EXPERIMENTS ON THE PASSAGE OF HIGH-ENERGY PROTONS IN DENSE MATTER. S. P. Shen (New York Univ., New York).

A series of experiments designed to study the nuclear cascade resulting from the passage of 1 to 3 Bev protons in matter has been in progress at the Brookhaven Cosmotron. Preliminary results on the fluxes of fast neutrons (upper limits) and of strongly-interacting particles above 50 Mev are summarized here. The four cases studied are: 1-Bev protons on Fe, on chondritic material, and on $C_5H_8O_2$, and 3-Bev protons on Fe. 23 references. (auth)

**18392** (TID-7652(p.866-75)) THE BIOLOGICAL HAZARDS OF $\pi$ AND $\mu$ MESONS. B. L. Murphy, P. Kitching, and H. B. Knowles (Yale Univ., New Haven).

The biological hazard of both kinds of $\pi$ and $\mu$ mesons was very roughly evaluated for the purpose of estimating shielding about a meson factory. Certain processes relative to the probable interactions of stopped mesons are discussed in detail because of their relevance to shielding against high energy proton fluxes. In particular, stopping $\pi^-$ mesons appear to be of the order of ten times more dangerous than neutrons of the same energy, and the importance of this ratio is noted for the case of thin space shields. Techniques for an improved calculation of the hazard are considered. (auth)

**18393** (TID-18316) ENVIRONMENTAL MONITORING REPORT, THIRD QUARTER 1961. P. C. Adams (Mound Lab., Miamisburg, Ohio). Nov. 15, 1961. Contract AT (33-1)-Gen-53. 21p.

The concentration of radioactive materials detected in the environment surrounding Mound Laboratory, Miamisburg, Ohio, during the third quarter of 1961 is presented. The concentration of Po and tritium in the Great Miami River was within the maximum permissible level recommended by the National Committee on Radiation Protection and Measurements. The concentration of Po and Pu in the environmental air was also within the maximum permissible level recommended by the National Committee on Radiation Protection and Measurements. There was no detectable concentration of tritium in the environmental air during the quarter. (auth)

**18394** (TID-18317) ENVIRONMENTAL MONITORING REPORT, FOURTH QUARTER, 1961. P. C. Adams (Mound Lab., Miamisburg, Ohio). Jan. 15, 1962. Contract AT(33-1)-Gen-53. 23p.

The concentration of radioactive materials detected in the environment surrounding Mound Laboratory, Miamisburg, Ohio, during the fourth quarter of 1961 is presented. The concentration of polonium and tritium in the Great Miami River was within the maximum permissible level recommended by the National Committee on Radiation Protection and Measurements. The concentration of polonium and plutonium in the environmental air was also within the maximum permissible level recommended by the National Committee on Radiation Protection and Measurements. There was no detectable concentration of tritium in the environmental air during the quarter. (auth)

**18395** (TID-18318) ENVIRONMENTAL MONITORING REPORT, SECOND QUARTER 1962. P. C. Adams (Mound Lab., Miamisburg, Ohio). Aug. 4, 1962. Contract AT(33-1)-Gen-53. 23p.

The concentration of radioactive materials detected in the environment surrounding Mound Laboratory, Miamisburg, Ohio, during the second quarter of 1962 is presented. The concentration of Po and tritium in the Great Miami River was within the maximum permissible level recommended by the National Committee on Radiation Protection and Measurements. The concentration of Po and Pu in the environmental air was also within the maximum permissible level recommended by the National Committee on Radiation Protection and Measurements. There was no detectable concentration of tritium in the environmental air during the quarter. (auth)

**18396** (UCRL-10215) HEALTH PHYSICS ASPECTS OF WHOLE-BODY IRRADIATION. Graham M. Hairr (California. Univ., Berkeley. Lawrence Radiation Lab.). June 20, 1962. Contract W-7405-eng-48. 23p.

Techniques are described of lymphatic leukemia therapy by massive doses of yttrium-90 administered intravenously. A desired further application is suppression of the immune mechanism prior to tissue transplant. For assurance of purity the yttrium-90 has been processed at the site from multicurie shipments of strontium-90. Health physics problems that had to be resolved are outlined. These include development of shielded and remotely operated $Y^{90}$ extraction equipment; development of equipment for preliminary animal experimentation; and development of carrying containers for intralaboratory movement of curie quantities of beta emitters. The final development problem produced an enclosure to comfortably house a human patient and the associated medical equipment for his treatment, providing adequate shielding for the attending medical team, and yet providing for quick access in case of a medical emergency. Control methods were also developed for keeping radioactive contamination from spreading after the patient was transferred to a conventional hospital room which, for medical reasons, had to be pressurized for reverse isolation. (auth)

**18397** (ZFK-WF-18) EXPLOSIONSGEFAHR UND SAUERSTOFFKONZENTRATION IN STICKSTOFFKRYOSTATEN FÜR REAKTORBESTRAHLUNG. (Explosion Hazards of Oxygen Concentration in Nitrogen Cryostats for Reactor Irradiation). Lothar Heyne (Germany. Zentralinstitut für Kernphysik, Dresden). Mar. 1962. 14p.

There is a connection between the concentration of $O_2$ and the danger of explosions in $N_2$ cryostats used in reactor irradiations. In cryostats which operate with commercial liquid $N_2$ the ratio of $O_2$ in the liquid increases during operation owing to the different velocities of evaporation of the two components ($N_2$ and $O_2$). There is a value of saturation for the concentration of $O_2$, which de-

pends on principle and construction of the cryostat. Values extend from 12% (cryostat at Harwell) to 1% (flowing off cryostat) and to about 0.1% (thermo siphon cryostat). Radioinduced production of $O_2$ during reactor irradiation is negligible. (auth)

**18398** RADIATION EXPOSURE IN CHILDREN WITH HEART DISEASE. Madison S. Spach (Duke Univ., Durham, N. C.). Am. Heart J., 64: 726-9(Dec. 1962).

To evaluate the possible excessive radiation exposure of children with heart defects, dosimetry data for pediatric radiodiagnostic procedures were compiled. Means were also sought for reducing exposure to minimal levels consistent with adequate diagnostic practices. When fluoroscopy is necessary, a 10- to 50-fold reduction in exposure can be obtained by substituting the image amplifier for the regular fluoroscope. Pediatric exposure with techniques employing radioisotopes is also evaluated, especially those involving $I^{131}$. If $I^{131}$-Hippuran is used for renal studies, it is rapidly excreted by the kidneys, so that the effective half life in the body is less than 1 hr, even with poor renal function. Precautionary measures include administration of iodine (to block the uptake of $I^{131}$ by the thyroid gland) and adequate hydration to insure early voiding (to minimize pelvic irradiation). With these measures, when 15 $\mu$C are injected into a child weighing 40 kg, the whole-body beta dose is ~0.0002 rad, and the gamma dose is 0.00013 r. The gonadal exposure from $I^{131}$ (in the dosage mentioned) is significantly less than gonadal exposure from routine chest films and fluoroscopy. The present consensus is that radioisotopes should be used in children only for situations in which information cannot be gained by other methods. Moreover, fluoroscopy of pediatric cardiac patients as a routine procedure in office practice should not be performed since x-ray films usually supply adequate information. (TCO)

**18399** ELIMINATING THE HAZARDS FROM RADIATION. Costantino Zaino. Am. J. Nursing, 62: 60-1(Apr. 1962).

Recommendations of protective measures to be used by nurses exposed to ionizing radiations are outlined. (H.H.D.)

**18400** PROTECTING THE ENVIRONMENT AROUND A NUCLEAR POWER REACTOR—A STATE HEALTH DEPARTMENT ACTS. Sherwood Davies (New York State Health Dept., Albany). Am. J. Public Health, 52: 1993-2000(Dec. 1962).

A comprehensive radiological monitoring program for the environment within a 20-mile radius of a nuclear power reactor plant at Indian Point, N. Y., is described. An emergency plan was also devised to estimate how much radioactivity from an accidental release would be taken up by milk cows, crops, and water supplies. Should an accident occur, the estimates will provide a sound basis for deciding whether countermeasures are needed to protect consumers of affected food and water. It is believed that this is the first time that a state health department has devised an extensive plan to protect the environment surrounding a nuclear power reactor. (P.C.H.)

**18401** RISK OF TUBERCULOUS INFECTION AND OF RADIATION AMONG UNIVERSITY STUDENTS. Nandor Szent-Gyoergyi (Univ. of Chicago). Am. Rev. Respirat. Diseases, 83: 432-5(Mar. 1961).

The student population of the University of Chicago was divided into general and special risk groups to assess the relative necessity of frequent x-ray examinations in the 2 groups. Positive tuberculin tests were detected in 5.9 and 32.5% of the 2 groups, respectively, and the conversion rate (to positive tests) was 0.9% for the general risk and 6.4% for the special risk groups. Thus, both positive tuberculin skin test and conversion rate were significantly higher among foreign-born, nonwhite, and medical students than among native white students. The findings indicate the necessity of more frequent skin testing and roentgenography in the special risk group, thus permitting reduction of the radiation hazard and the cost of the tuberculosis control program in the largest part (80.9%) of university students without endangering the effectiveness of the program. In view of the findings of this study, it may be possible to further reduce the frequency of x-ray microfilming. After the initial skin test and microfilm, the skin test can be repeated in the special risk group yearly, but microfilms used only in positive skin-test cases. (H.H.D.)

**18402** AN INTRODUCTION TO HEALTH PHYSICS MEASUREMENTS. R. J. Sherwood (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Ann. Occupational Hyg., 4: 90-103(Dec. 1961).

A review is given on: forms of radiation and units of measurement; maximum permissible doses and concentrations of radioactivity, means of detection and monitoring radioactivity, and other general principles of health physics in controlling radiation hazards. (P.C.H.)

**18403** THE EXTERNAL HAZARD FROM $\beta$ AND $\gamma$ RADIATION SOURCES. K. H. Gardner (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Ann. Occupational Hyg., 4: 137-47(Dec. 1961).

Maximum permissible levels for occupational exposure are discussed and various aspects of assessment of hazards to exposed workers are considered. The successful control of external radiation requires the choice of suitable techniques, facilities, and monitoring equipment. Discussion is given on: strength of radiation source; closeness of approach to the source; dose rates at working positions; frequency and length of time operators will be exposed; shielding; and instructions to avoid accidents and to deal with emergencies. One important general principle is that sources should never be picked up with bare or gloved hands. Various types of monitoring equipment are described and their application under different circumstances considered; the instruments include dosimeters, film badges, survey meters using ion chambers, and monitors with visible or auditory alarms. A hot-spot survey meter with extension rods for detecting contaminated areas is described in detail. For successful control of the external $\beta$-$\gamma$ hazard each series of operations must be planned in advance, suitable equipment and monitoring instruments provided, and emergency instructions formulated. (P.C.H.)

**18404** THE MONITORING OF SURFACE CONTAMINATION AND ITS PLACE IN RADIOLOGICAL PROTECTION. H. J. Dunster (United Kingdom Atomic Energy Authority, Harwell, Berks, Eng.). Ann. Occupational Hyg., 4: 148-51 (Dec. 1961).

Maximum permissible values for surface contamination in installations using radioactive materials are proposed. The values for $\alpha$ and $\beta$ activity, respectively, are $10^{-3}$ to $10^{-4}$ and $10^{-3}$ $\mu$c/cm$^2$ for controlled areas; $10^{-4}$ to $10^{-5}$ and $10^{-4}$ $\mu$c/cm$^2$ for low-activity or inactive areas; and $10^{-5}$ and $10^{-4}$ $\mu$c/cm$^2$ for skin. As well as specifying the permissible surface concentration of radioactivity, it is also necessary to consider the area over which measurements may be averaged. In practice, the area chosen is usually that of the measuring instrument and will be of the order of 100 cm$^2$. Where large areas, such as floors, have to be monitored, there are considerable advantages in using an instrument with a larger measuring area, but the area can-

not be extended indefinitely or the local radiation levels from highly localized patches of contamination may become unacceptably high. Surface contamination monitoring can provide a general indication of the degree of control that is being maintained over operations with radioactive materials. If contamination levels are below those recommended above, it is unlikely that the contamination will be of any danger to health. (P.C.H.)

**18405** AIR SAMPLING: SOME PROBLEMS. W. N. Saxby (United Kingdom Atomic Energy Authority, Aldermaston, Berks, Eng.). Ann. Occupational Hyg., 4: 152-8 (Dec. 1961).

The problems of monitoring occupational hazards in installations in which radioactive dust is present atmospherically are described. Sampling techniques and equipment are also described. Various types of filter paper or membranes may be used for collection of the airborne particulates. In general, filter papers are not 100% effective collectors and collection efficiency is dependent upon particle size and the speed at which the air stream is sampled. However, certain glass fiber type filter papers, if used at a sufficiently high sampling speed (>10 cm/sec), have an efficiency of sampling collection of about 95 to 99%. They have, moreover, the advantage that almost all the material is collected on the upstream surface of the sampling filter, which helps counting efficiency for radioactive materials. Membrane filters can also be used and are more highly efficient, but generally require a very heavy pump effort and sampling speed is low. A useful approach is to make up scintillators by spreading ZnS carefully over the sticky side of Scotch-type tape and to view this directly with the photomultiplier. Various systems using coincidence counting techniques, $\beta$-absorption measurements, changes in $\alpha/\beta$ ratio, and other techniques are proposed for monitoring plutonium works. (P.C.H.)

**18406** EVALUATION OF HAZARDS OF RADIATION EXPOSURE IN MEDICAL PRACTICE. L. H. Hempelmann (Univ. of Rochester, N. Y.). Ann. Rev. Med., 12: 151-64 (1961).

**18407** GENERAL PRINCIPLES OF MEDICAL PROTECTION AGAINST THE HAZARDS OF IONIZING RADIATIONS. S. Halter. Arch. Belges Med. Sociale, Hyg., Med. Travail Med. Legale, 19: 149-56(Mar. 1961).

A review. (H.H.D.)

**18408** LOSS, RECOVERY, AND ACTIVITY CONTROL OF A RADIUM CAPSULE. H. Luethy (Universitätsinstitut für Röntgendiagnostik und Strahlentherapie, Basel). Atompraxis, 9: 51-2(Feb. 1963). (In German)

The loss of a 20-mg radium preparation (1 mm Pt filter) which was contained in a catheter is reported. Through the negligence of untrained personnel the catheter landed in the waste disposal. The radium unit was exposed to a temperature of 1000°C in the incinerator, and was finally found intact in the rubbish pit. The emanation loss caused a brief 4% decrease in activity, but a month later activity had returned to normal. (auth)

**18409** THE DECONTAMINATION OF FABRICS WITH POLYPHOSPHATE SOLUTIONS. F. Reiff (J. A. Benckiser GmbH, Ludwigshaften/Rhein, Ger.), K. Schuster, and H. Heinen. Atompraxis, 9: 58-63(Feb. 1963). (In German)

Various kinds of fabrics (wool, cotton, synthetic fibres) charged with radioisotopes were decontaminated to a large extent when treated in a household washing machine with polyphosphate even though the working conditions are very much more difficult than under normal circumstances. The washing bath contains 90% and more of radioactive substances, which must be rendered innocuous. (auth)

**18410** STUDIES ON THE DECONTAMINATING EFFECT OF A RAPID FILTER PLANT UNDER NORMAL OPERATING CONDITIONS. H. Bernhardt. Atompraxis, 9: 64-7(Feb. 1963). (In German)

The slight rise in the total beta activity of dam-reservoir water as a result of the Russian atomic bomb tests in September 1961 made it possible to observe the decontaminating effect of the rapid-filter plant at the Wahnbach Dam under normal operating conditions. The decontaminating effect was calculated from the difference in activity between unpurified and purified water, and was compared with data listed in the literature. In addition, the amount of radioactivity retained by the sand filters during a set period of time was determined and related to the amount of water filtered during the same period. The value thus obtained agreed essentially with the value calculated from the difference between the activity of unpurified and purified water. It was found that the amount of activity remaining in the filter sand after rinsing is slight, and can be ignored. (auth)

**18411** THE HAZARDS OF RADIATION. Edward Teller (Univ. of California, Berkeley). Calif. Med., 97: 257-62(Nov. 1962).

Opinions are presented in support of the contention that the hazards of radiation to man have been greatly exaggerated. (TCO)

**18412** FALLOUT: WHAT A HOSPITAL CAN DO ABOUT IT. George W. Peck (Department of National Health and Welfare, Ottawa). Can. Hosp., 39: 46-93 (June 1962).

Protection of hospital patients and personnel from fallout resulting from thermonuclear war is discussed, and a description is given of plans that are being developed to examine and assess the requirements for protected units in hospitals, both new and existing. Pilot studies of Canadian hospitals indicate that, within the scope of existing buildings, much can be done to adjust the hospital program to cope with fallout hazards. Also, provision can be made for shielding the essential functions of the hospital, and for continuing the vital services of a hospital during a period of gross radiation hazard. Procedures are developed to enable local authorities to evaluate the fallout shelter potential of existing hospital structures, and guidance is also provided for the improvement of both radiation shielding and general habitability. Tabulated data are provided showing the space requirements for various categories of hospital shelter occupants and for operating facilities. Floor plans, showing maximum utilization of space yet providing a high degree of protection to hospital occupants, are illustrated. Hospital facilities provided for in the emergency plans include ventilation, power, and illumination supply, food preparations, sanitation (sewage, garbage, and waste disposal), and storage of drugs and other medical supplies. (TCO)

**18413** RADIATION HAZARDS IN DIAGNOSTIC RADIOLOGY. D. J. Duffy (Federal Ministry of Health, Salisbury, Southern Rhodesia). Central African J. Med., 7: 213-14(June 1961).

A review. (H.H.D.)

**18414** CODES OF PRACTICE FOR THE USE OF IONIZING RADIATIONS. J. E. Roberts (Middlesex Hospital Medical School, Eng.). Contemp. Phys., 4: 176-86(Feb. 1963).

Ionizing radiations represent a health hazard that has increased enormously in recent years in many fields, including education. Unfortunately, it is veiled in some degree of mystery, being unseen and unheard. If ionizing radiations

were visible, audible or tangible, problems of setting up regulations and codes of practice would be greatly simplified. Furthermore, the lower levels of hazard are of necessity uncertain so that a considerable margin of safety must be included in any rules. With the best will in the world, it is inevitable that the restrictions imposed will lead to a degree of frustration and annoyance, particularly in the research laboratories. Nevertheless, experience has shown that research and teaching can be carried on without difficulty whilst keeping well within the limitations imposed. Indeed, particularly in the case of work with radioisotopes, the rules for minimizing the health hazard undoubtedly result in a bonus of improved experimental technique. (auth)

**18415** THE EFFECT OF THE ATOMIC BOMB EXPLOSIONS OVER HIROSHIMA AND NAGASAKI. H. Kleinsorge and W. May (Medizinische Universitäts-Poliklinik, Jena, Ger.). Deut. Gesundheitsw., 16: 2031-8(Oct. 1961).

A review. (H.H.D.)

**18416** THE RADIUM DEPARTMENT OF A HOSPITAL. A. Verhagen. Geburtsh. Frauenheilk., 21: 1041-7(Nov. 1961).

Procedures for handling Ra are discussed. (H.H.D.)

**18417** THE HEALTH PHYSICS ASPECTS OF THE SL-1 ACCIDENT. John R. Horan and William P. Gammill (Idaho Operations Office, AEC, Idaho Falls, Idaho). Health Phys., 9: 177-86(Feb. 1963).

With so few accidents in the atomic energy industry, new concepts and procedures of interest to the Health Physics profession will result from a critical analysis of each major radiation accident. A brief description of the reactor, its purpose, and operating history prior to the accident is followed by a comprehensive treatment of the health physics activities. Emergency personnel working under adverse conditions in radiation fields, ranging up to 800 r/hr, received whole body exposure doses up to 27 r. Many unique problems were associated with the recovery and decontamination of the bodies. Environmental monitoring revealed that the airborne radioactive material was essentially all iodine-131 and was well below the Radioactivity Concentration Guide value for the offsite population. Analysis of soil and air samples indicated that the reactor building was quite effective in containing the fission products during and following the excursion. Included are data on direct radiation levels experiences in the vicinity of SL-1 and the rate of decay of the primary source. The major lessons learned from the accident are summarized. (auth)

**18418** RADIATION REGULATIONS. G. Hoyt Whipple (Univ. of Michigan, Ann Arbor). Health Phys., 9: 221-4 (Feb. 1963).

A number of psychological, social, and technological factors have given an importance to the regulation of radiation exposure scarcely justified by the threat, immediate or potential, which radiation poses to human safety. Starting with the recommendations of the ICRP and the NCRP, advisory and regulatory bodies have produced codes, regulations, standards, guides, and laws. As these become more specific, detailed, and restrictive, the health physicist working for an AEC licensee has less opportunity to exercise technical judgment and more need to understand and follow the letter of the law. Radiation protection regulations from six points of view are reviewed: the producer, the public, the regulator, the user, the worker, and the health physicist. (auth)

**18419** THE ROLE OF THE U. S. PUBLIC HEALTH SERVICE IN STIMULATING STATE AND LOCAL RADIOLOGICAL HEALTH PROGRAMS. Russell I. Pierce and Roscoe H. Goeke (Public Health Service, Washington, D. C.). Health Phys., 9: 225-8(Feb. 1963).

Under the Constitution, the responsibility for health protection is vested in the States. Therefore, the role of the Public Health Service in stimulating state and local radiological health programs is limited to consultation, program planning, assignment of personnel to the state program, loan of equipment, training of personnel, and providing funds through a system of matching grants. Each of these functions is discussed, and emphasis is placed on the Public Health Service goal of building up strong radiological health capabilities in the States. (auth)

**18420** PROGRAMMED LEARNING IN RADIATION PROTECTION TRAINING. W. P. Howell (General Electric Co., Richland, Wash.). Health Phys., 9: 236-8(Feb. 1963). (HW-SA-2585)

An investigation was made of programmed learning methods in the Irradiation Processing Dept. at Hanford. The results are described and the limitations of the methods are outlined. (D.L.C.)

**18421** THE HAZARDS OF MEDICAL IRRADIATION. R. J. Bloor. Henry Ford Hosp. Med. Bull., 9: 471-4 (Dec. 1961).

**18422** STUDY OF RADIATION EXPOSURE TO GONADS OF PRESCHOOL BOYS FROM DIAGNOSTIC DENTAL ROENTGENOGRAMS. Leonard F. Menczer (Hartford Health Dept.). J. Am. Dental Assoc., 66: 30-41(Jan. 1963).

A study of 41 x-ray machines in 31 private dental offices in the Greater Hartford area showed that every x-ray unit permitted gonadal radiation exposure, ranging from 8 to 88 Mr. With few exceptions, the timing devices on all units were inaccurate by as much as ½ sec. About 20% of the units needed some mechanical repair, and 7 units demonstrated excessive leakage radiation. In 50% of the dental offices, x-ray film was purchased on a cost basis rather than on a quality basis. The average length of exposure per film ranged from ¾ to 4 sec; the usual exposure was from 1¼ to 2¼ sec. No x-ray unit was on an independent electrical supply. Timer cords were usually no more than 5 ft long and did not permit the operator to get into a more protected position when exposing dental roentgenograms. In several instances the x-ray unit was close to business offices or to treatment rooms. The attitude of the average dentist in the study toward the potential hazards of x-ray radiation to his office personnel and patients was poor or showed lack of concern. Recommendations for reduction of gonadal radiation exposure are given. (TCO)

**18423** REMOVING RADIOSTRONTIUM FROM MILK. CURRENT STATUS OF A PILOT PLANT PROCESS. L. F. Edmondson, H. E. Walter, A. M. Sadler, F. P. Hanrahan, D. G. Easterly, J. Y. Harris, D. H. Keefer, and A. R. Landgrebe (Department of Agriculture, Washington, D. C.). J. Dairy Sci., 45: 800-3(June 1962).

A tentative process was adapted to the pilot plant stage. Research with the pilot plant indicates that the process could be adopted commercially in the event that radiostrontium in milk should reach dangerous levels. The process is based on the ion-exchange principle, and ~90% of the Sr in milk can be removed with only a minimum of adverse changes in the milk's chemical composition, physical stability, or flavor. The cost of materials used for the process (~¾¢/qt) is primarily that of the salts used to regenerate the columns. The estimate is based on a process that reuses the salt solutions so that

maximum efficiency is obtained. If the regenerating solution is not recovered, the cost may be as high as 3¢/qt. Optimum procedures for cleaning the resin, removing Sr from the exhausted resin, and regenerating the resin for reuse are described. The pilot plant was used to process milk obtained from a cow fed measured doses of radiostrontium, for evaluation of the process, as $Sr^{85}$ rather than $Sr^{90}$. (TCO)

**18424** IONIZING RADIATION CONTROL. E. W. Campbell (Department of Health and Welfare, Augusta, Me.). J. Maine Med. Assoc., 51: 390-3(Nov. 1960).

The proceedings and recommendations stemming from a conference of New England and Middle Atlantic State public health radiation officers, held on December 15, 1959, are reported. Preliminary surveys of background radiation variations in Maine are also reported, particularly for water supplies in certain geologic regions. Present surveys indicate that there is a broad band of radioactivity extending in a generally northwest to southeast direction from the vicinity of Rumford to the ocean at Brunswick or Georgetown. About 250 wells were investigated and found to contain higher amounts of radioactivity than the maximum permissible level of 2000 μμC/l. A research project was undertaken whereby samples were collected from as many sources as possible, centering the activities in the vicinity of Raymond but extending out from there to Brunswick on the east, to the west shore of Sebago Lake, and north through Paris to the Rumford and Mexico area. Needs for increased monitoring of radioactivity in sea water, sea weed, and shellfish near the Portsmouth, N. H., shipyard, where atomic submarines are being constructed and tested, are cited. (TCO)

**18425** RADIATIONS AND CARCINOGENESIS. John L. Tullis. J. Med. Soc. New Jersey, 58: 590-3(Dec. 1961).

After a review of the pertinent literature, it was concluded that radiations may be carcinogenic, given time, a susceptible host, and a large enough dose. In the adult, it seems that doses in the order of 1000 to 2000 r are required to cause induction of neoplasms. In fetuses and young children, less exposure is needed to produce tumors; as little as 200 r delivered to the thymus in infancy may produce leukemia, thyroid cancer, or other malignancy. There is some evidence that as little as 8 to 12 r delivered to the abdomen of a pregnant woman may play some part in the development of leukemia in her offspring. Radioinduced malignancies are characterized by a latent period of a few to many years' duration. It is suggested that physicians should avoid the unnecessary use of diagnostic x rays particularly in young children and pregnant women. It is also suggested that physicians should be alerted to the possibility of radiation as an etiologic agent in patients with a malignant lesion that is present in an organ previously exposed to large amounts of radiation either therapeutically or occupationally. (P.C.H.)

**18426** EFFECT OF RADIOACTIVE FALLOUT ON WATER SUPPLIES IN CONNECTICUT. William W. Ullman (State Dept. of Health., Hartford). J. New Engl. Water Works Assoc., 76: 197-206(Sept. 1962).

The surveillance program conducted by the State Health Department on 3 municipal water supplies during the period 1956-1961 with emphasis on the determination of gross beta activity in the water supplies under study and the correlation of the levels found with the thermonuclear testing programs of the U. S. and the U.S.S.R. is discussed. The data indicate a definite correlation in the levels of beta activity but point out that the measurable levels are well below those recommended by the Federal Radiation Council in its Radiation Protection Guides (RPG's). Information is included on the relative effects of various methods of water treatment on the removal of the radioactive materials, with certain suggestions in regard to the establishment of a statewide monitoring program. Consideration is given primarily to the problems of $Sr^{90}$, $Sr^{89}$, $I^{131}$, and $Cs^{137}$. (Public Health Eng. Abstr., 43: No. 3, Mar 1963)

**18427** RADIOLOGIC HAZARDS AFFECTING THE UNITED STATES AIR FORCE. A. F. Meyer. J. Occupational Med., 4: 258-61(May 1962).

Among the potential sources of exposure of Air Force personnel to ionizing radiation are: components of nuclear weapons, industrial radiography, static eliminators, luminescent markers, reactors, diagnostic and therapeutic medical uses, industrial tracer and measurement procedures, calibration of disaster control and post-attack survival instruments, disaster operations, and microwave generating equipment. Consideration is given to incorporation of a radiologic health protection program into the existing Air Force medical service which would apply the basic principles of personnel selection and periodic medical examination, design environmental controls and continuous environmental evaluation, and educate personnel concerning the potential occupational hazard. (Aerospace Med., Jan. 1963)

**18428** AT THE THRESHOLD OF ATOMIC HYGIENE. P. Gevaudan (Faculté de Médecine, Marseille). Maroc Med., 40: 889-94(Sept. 1961).

A general discussion of advances in radioprotection measures is presented. (H.H.D.)

**18429** DISASTER TRAINING. Richard D. Reese and Thomas A. Collins (Office of the Surgeon General, Washington, D. C.). Military Med., 127: 266-71(Mar. 1962).

Training directed toward disaster casualty control in the military, as exemplified by the specific programs conducted by the Air Force, is described. It is emphasized that the approach to casualty control must be oriented toward the full spectrum of disaster, with equal consideration of the type and scope of the disaster itself and the agent rendering casualty control service, whether it be the nonmedical individual in his survival self-help role or the medical profession in its larger role of contributing to national survival. (TCO)

**18430** RADIOACTIVITY OF BIOLOGICAL MATERIALS FROM BRAZILIAN AREAS RICH IN THORIUM COMPOUNDS. E. Penna-Franca and O. Gomes De Freitas (Instituto de Biofisica, Rio de Janeiro). Nature, 197: 1062-3(Mar. 16, 1963).

There are two types of high background areas in Brazil where the thorium content of the soil is high. These are regions of monozite sands in the states of Rio de Janeiro and Espirito Santo and regions of volcanic intrusives in the state of Minas Gerais. These areas of high background radiation afford great possibilities for investigations of long-term consequences to biological systems of continuous exposure to relatively high doses of radiation. (C.E.S.)

**18431** WHAT HAZARDS DOES DENTAL RADIOLOGY INVOLVE? Albert G. Richards (Univ. of Michigan, Ann Arbor). Odontol. Am., 4: 54-61(Mar.-Apr. 1961). (In Spanish)

**18432** STRONTIUM-90 IN MILK AND THE DIFFICULTIES OF ITS DETERMINATION. H.-E. Oberlaender (State Research Inst., Vienna). Oesterr. Milchwirtsch., 17: 330-3(1962).

Official supervision of radioactive contamination of milk

and dairy products in the whole of Austria was instituted about 2 years ago. Dried milk produced in October 1960 contained 13.5 $\mu\mu$C $Sr^{90}$/g Ca and cheese made in April 1961 in a low and a high rainfall area contained 10.8 and 17.0 $\mu\mu$C $Sr^{90}$/g Ca, respectively. (Public Health Eng. Abstr. 43: No. 3, March 1963)

**18433** X-RAY FILTER HEAD AND FILM HOLDER. F. J. Kratochvil and R. W. Longton (National Naval Medical Center, Bethesda, Md.). Oral Surg., Oral Med., Oral Pathol., 15: 1001-8(Aug. 1962).

To obtain constant and less distorted dental roentgenograms, a system was devised to hold the film perpendicular to the central and least divergent rays at a fixed distance, thereby limiting the field of radiation to the approximate area of film size. The purpose of the procedure is to produce a fixed, rigid system for orienting the film and x-ray source; to hold the film flat and perpendicular to the central rays and parallel to the long axis of the tooth; and to confine the radiation to the rectangular field of film size, thus reducing the amount received by the patient. A cone was constructed of aluminum, with a rectangular extension the same size as standard periapical film ($1\frac{5}{8}$ by $1\frac{1}{4}$). It was threaded and screwed directly into the head of an x-ray unit. The area around the base was poured with lead, which eliminated all rays except those traveling down the rectangular extension. The overall length of the tube extension was 12 in. A groove was cut in the side of the extension tube to receive the film holder, which allowed for adjustment, exact control, and reproduction of the target-film distance. With this device the field of radiation is limited to the film, area of radiation being reduced considerably (to ~$\frac{1}{5}$) from that of the normal short-cone exposure. Only that portion of the x-ray beam necessary to irradiate the film reaches the patient. The patient's participation is kept to a minimum, so that movement is virtually eliminated. (H.H.D.)

**18434** RADIATION PROTECTION AND RECOVERY. M. Maqsood (Michigan State Univ., East Lansing). Pakistan J. Health, 10: 126-44(Oct. 1960).

**18435** ZURICH REGULATIONS FOR RADIOMETRY IN CONVENTIONAL ROENTGEN THERAPY, IN MEGAVOLT THERAPY, AND IN PROBLEMS OF RADIATION PROTECTION. H. R. Schinz and R. Wideroe. Praxis (Bern), 50: 844-6(Aug. 1961). (In German)

**18436** ZIRCONIUM SCRAP BURNING TESTS. Quart. Nat. Fire Protect. Assoc., 56: 110-27(Oct. 1962). (In English)

A series of tests were carried out to obtain information on the fire behavior of scrap zirconium. Fourteen of the 21 tests are summarized. Those omitted duplicated those reported or were unsatisfactory because dryness could not be achieved. It was concluded that the rate of combustion of scrap zirconium chips and turnings tends to increase when the scrap is wet with water or water-soluble oil, with scrap depth, with partial containment, when the percent of void air space within the pile is increased, as the total amount of scrap ignited increases, and with increasing thickness of individual particles of scrap. The combustion rate was also influenced by the manner in which the scrap was ignited, the location of the exposing flame or heat, and by wind or drafts. (M.C.G.)

**18437** RADIATION PROTECTION TO THE PATIENT. A. Zuppinger (Universität, Bern). Radiol. Clin., 30: 286-9(1961). (In German)

Possible hazards of radiodiagnosis and their prevention are discussed. (H.H.D.)

**18438** RADIATION AND THE WORLD WE LIVE IN. Lauriston S. Taylor (National Bureau of Standards, Washington, D. C.). Radiology, 80: 359-68(Mar. 1963).

Radiation hazards to man and the technical and social problems involved in dealing with them are reviewed. It is pointed out that the basic dilemma at present is the lack of positive knowledge of the specific effects of radiation on man at low or even moderate exposure levels. This severely hampers measures directed at control of radiation exposure. The need for education of the public on radiation matters is stressed. (C.H.)

**18439** PATIENT EXPOSURE DURING FLUOROSCOPY. Earl R. Miller, John Kafafian, and Frank E. Maddison (Univ. of California, San Francisco). Radiology, 80: 477-85(Mar. 1963).

An apparatus is described which, when attached to the fluoroscope and calibrated, can be made to read within clinically acceptable limits the energy in square centimeter roentgens applied to the patient during a fluoroscopic session. If the quality of the beam is kept constant during the fluoroscopic session, the dose absorbed by the patient can be read directly in gram rads within clinically acceptable limits. The energy applied to and absorbed by patients during upper gastrointestinal studies, barium enema examinations, and other diagnostic procedures was measured. Experienced examiners using a 5-inch image intensifier gave, on the average, only about one-fourth to one-fifth as much radiation to the patient as did the less experienced examiners using a conventional fluoroscope for the same kind of examination. The more experienced examiners did their studies more quickly and with smaller field sizes. Comments are given about the square centimeter roentgen as a unit for patient-exposure. (auth)

**18440** DIAGNOSTIC RADIOLOGY IN CHILDHOOD. ITS LIMITATIONS AND RISKS. Jorge Pacheco and J. Schwarzenberg (Hospital San Juan de Dios, Santiago, Chile). Rev. Chilena Pediat., 32: 162-6(Mar.-Apr. 1961).

The possible genetic and leukemogenic hazards of x-ray examinations of infants and children are discussed. (H.H.D.)

**18441** ABUSES AND COMPLICATIONS OF ROENTGEN THERAPY OF PAIN. G. R. Ledoux-Lebard and Y. M. Laurent. Rev. Praticien, 11: 2235-40(Sept. 1, 1961).

**18442** COMMON SENSE IN THERAPEUTIC IRRADIATION. R. R. Newell (Stanford Univ., Calif.). Rocky Mt. Med. J., 58: 33-6(Aug. 1961).

The hazards of radiotherapy and the relative advantages of conventional, supervoltage, and megavoltage therapy are discussed. It was concluded that the relatively expensive, high-voltage devices have comparatively few advantages over conventional x-ray devices. (H.H.D.)

**18443** OPERATIONAL PRECAUTIONS AT NUCLEAR POWER STATIONS. C. A. Adams. Roy. Soc. Health J., 82: 255-61(Oct. 1962).

Sources of radioactivity incident to the operation of nuclear power stations are identified. Measures to protect station staff and the public are discussed, including the responsibilities of the station health physicist. The requirements for surveillance of safety measures are described. (Public Health Eng. Abstr., 43: No. 3, March 1963)

**18444** DANGER AND PROTECTION AGAINST SECONDARY RADIATION (PRESENT STATUS OF THE QUESTION). R. Van Rossum. Scalpel, 114: 551-9(June 17, 1961).

Sources of secondary radiation as well as its hazards, means of detection, permissible doses, means of protection, and significance to radiologists, technicians, and the general population are discussed. (H.H.D.)

**18445** DOSIMETRY OF ATOMIC BOMB RADIATION IN HIROSHIMA BY THERMOLUMINESCENCE OF ROOF TILES. Takenobu Higashimura, Yoneta Ichikawa, and Tunahiko Sidei (Kyoto Univ.). Science, 139: 1284-5 (Mar. 29, 1963).

Thermoluminescence was used to determine the distribution of gamma dose, heretofore unknown, from the atomic bombs dropped on Hiroshima and Nagasaki. Roof tiles irradiated by the bombs showed intense thermoluminescence, and the radiation dose for samples irradiated below 100 r by the bomb was measured by this method. (auth)

**18446** STONTIUM-90 CONTENT OF DECIDUOUS HUMAN INCISORS. Harold L. Rosenthal, John E. Gilster, and John T. Bird (Washington Univ., St. Louis). Science, 140: 176-7(Apr. 12, 1963).

The concentrations of strontium-90 in deciduous incisor teeth of children born in St. Louis between 1949 to 1957 are in accord with estimated bone levels, suggesting that human deciduous teeth are useful as an index of strontium-90 accumulation during the time the teeth are formed. (auth)

**18447** RADIOLOGICAL MONITORING FOR WATER WORKS PERSONNEL. PARTS I AND II. J. P. Hart (Oklahoma City Water Dept.). Southwest Water Works J., 44: Nos. 8-9, 10-15, 30-33(Nov.-Dec. 1962).

Water supplies, instrumentation, fallout, and shielding are discussed. A vocabulary of radioactivity is also included and the use of 2 nomograms is explained. (P.C.H.)

**18448** PROTECTIVE MEASURES AGAINST RADIATION. Wolfgang Pohlit and Boris Rajewsky (Max-Planck-Institut für Biophysik, Frankfurt am Main). VDI (Ver. Deut. Ing.) Z., 105: 176-7(Feb. 1, 1963). (In German)

Legal rules for radiation protection and medical questions concerning radiation protection are discussed. (M.C.G.)

**18449** HEALTH HAZARDS FROM MICROWAVE RADIATION. J. T. McLaughlin. Western Med., 3: 126-30(Apr. 1962).

Microwaves affect man adversely in at least four ways: by raising tissue temperatures to intolerable levels and causing cellular damage or death; emanation of x rays from microwave equipment is a danger and one to be guarded against; molecular absorption of microwaves may interfere with cellular physiology in an infinite number of ways; and microwaves, directly as heat, or in some other manner, act as stressers and set off the stress reaction with its undesirable sequelae. Experimental work to date demonstrates the danger of exposure to microwaves of 12.25 cm. A review of the existing literature and clinical findings (abnormal capillary fragility, clot retraction, bleeding, and purpura) on a group of people exposed to microwaves are included. (Aerospace Med., Jan. 1963)

**18450** ON THE PROBLEM OF CARCINOGENESIS BY ROENTGEN AND GAMMA RAYS. E. G. Mayer (Universität, Vienna). Wien. Med. Wochschr., 111: 377-9(June 3, 1961).

A discussion of the possible role of diagnostic radiation in the development of cancer is presented. (H.H.D.)

**18451** GENETIC RADIATION HAZARDS. F. Mainx (Universität, Vienna). Wien. Med. Wochschr., 111: 668-9 (Oct. 14, 1961).

**18452** RADIATION PROTECTION AND RADIATION HAZARDS. Karl Wasserburger (Krankenhaus der Stadt Wien-Lainz, Vienna). Wien. Med. Wochschr., 111: 706-10(Oct. 28, 1961).

**18453** SHIELDED PERSONNEL MONITORING STATION (Engineering Materials). (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). 8 drawings. (CAPE-924)

A shielded monitoring station was designed for use in whole-body counting. The station is located in a small, concrete block house 40 ft × 40 ft 6 in. It contains a reception room, women's dressing room, men's dressing room, janitor quarters, equipment room, storage room, instrument room, and the monitoring cell. The cell is 9 ft × 10 ft and has $10\frac{1}{4}$-in. steel walls with stainless steel facing. The door is the same construction and moves on rollers to open. (F.E.S.)

**18454** RADIOLOGICAL HEALTH DATA MONTHLY REPORT, VOLUME IV, NUMBER 2. (Public Health Service, Washington, D. C.). Feb. 1963. 45p. (RHD-Vol. IV, No. 2). $0.50(GPO)

Data are presented on radioactivity in samples of air, precipitation, surface water, water supplies including cistern water, milk, and other foods collected from 1960 through 1962. Data are included on levels of stable Sr, $Sr^{90}$, and $Cs^{137}$ in human and animal foods and levels of radioactivity in samples of air and water collected at the site of Project Chariot, Cape Thompson, Alaska. (C.H.)

**18455** RADIOLOGICAL HEALTH DATA MONTHLY REPORT, VOLUME III, NUMBER 10. (Public Health Service, Washington, D. C.). Oct. 1962. 48p. (RHD-Vol. III, No. 10). $0.50(GPO)

Data are presented on radioactivity in samples of air, precipitation, surface water, drinking water, milk, and other foods, and concentrations of $Sr^{90}$ in wheat and milling products collected during 1962. Results are presented from whole-body assays for $Cs^{137}$ in residents of West Germany performed during 1962. External environmental levels of radioactivity were measured at various stations throughout the country during July 1962 and at Hanford Atomic Products Operation, Lawrence Radiation Laboratory, Los Alamos Scientific Laboratory, and the Nevada Test Site. Results are tabulated. Information is summarized on announced nuclear detonations during September 1962. (C.H.)

**18456** RADIOLOGICAL HEALTH DATA MONTHLY REPORT, VOLUME III, NUMBER 9. (Public Health Service, Washington, D. C.). Sept. 1962. 72p. (RHD-Vol. III, No. 9). $0.50(GPO)

Data are presented on radioactivity in samples of air, precipitation, surface water, milk, and other foods collected during 1961 and 1962. Data are included on levels of $Sr^{90}$ in bones and animal feeds. Environmental levels of radioactivity during the last half of 1961 are presented for the Oak Ridge Area, the Portsmouth Gaseous Diffusion Plant Area, and the Savannah River Plant Area. Information is summarized on the location, date, yield range, and type of test of nuclear detonations during August 1962. (C.H.)

# INDUSTRIAL APPLICATIONS OF ISOTOPES AND RADIATIONS

**18457** (AD-283644) FLAVOR CONTROL OF IRRADIATED BEEF. Report No. 4 (Final Report), July 1, 1959–June 30, 1960. Lloyd E. Brownell (Michigan. Univ., Ann Arbor). Contract DA-19-129-QM-1419. 17p.

A series of investigations was conducted to evaluate the effects of a synthetic mixture of biochemical constituents on the induction of off-flavor during radiation processing of beef. Mixtures of $\beta$-carotene, $\alpha$-tocopherol, and glucose gave the most acceptable product. The addition of 0.05% chlorophyll also improved the flavor of irradiated beef. Elevated temperature during irradiation also improved the flavor of beef. (C.H.)

**18458** (AD-283645) A STUDY OF FLAVOR OF IRRADIATED MEAT. Report No. 4 (Annual) January 14, 1961–January 13, 1962. Howard G. Schutz (Battelle Memorial Inst., Columbus, Ohio). Contract DA-19-129-QM-1734. 22p.

A method for preparing chemicals for evaluation was developed, utilizing fresh meat as a carrier. The possible psychophysical techniques for use in the project were reviewed. The rating of irradiation odor intensity was chosen as a general measure. A special technique for characterizing odorants was developed, called the matching-standards method. It was thoroughly tested using a 20-member panel and found to be highly valuable and sufficiently valid to be useful in the program. (auth)

**18459** (AD-284068) RESISTANCE OF MICROORGANISMS IONIZING RADIATION APPLIED TO FOOD. Report No. 9 (Final) January 2, 1960–February 28, 1962. A. W. Anderson (Oregon. Agricultural Experiment Station, Corvallis). Contract DA-19-129-AM-1517. 10p.

Mild heat treatment applied after irradiation reduced the survival of C. botulinum spores in raw ground beef. Heat applied before or during irradiation appears to increase spore survival at 175 to 185°F. Sodium chloride, calcium chloride, citrate, nitrite, mustard oil (allyl isothiocyanate), nutmeg, sodium citrate, and Versene reduced the dose of radiation required to inactivate C. botulinum spores in raw ground beef. Of those listed above sodium chloride, nitrate, and nitrite are the most effective. (auth)

**18460** (NYO-10186) EVALUATION OF BETA RADIATION AS A HYDROGENATION CATALYST. Interim Technical Status Report No. 3, September 1, 1962–December 31, 1962. P. M. Yavorsky and E. Gorin (Consolidation Coal Co. Research and Development Div., Library, Penna.). Feb. 1, 1963. Contract AT(30-1)-2978. 33p.

Nine radiation-hydrogenation runs were completed with the reactions exposed to 0.98 megarad of beta radiation at elevated temperatures and pressures. No significant radiation induced hydrogenation of aromatic bonds occurs for the simple aromatics, methylnaphthalene and biphenyl. Likewise, $H_2$ addition to coal extract is not significantly promoted by radiation at 429°C and 5000 psi of $H_2$. In the case for methylnaphthalene and coal extract, there is, however, some evidence of selective radiation induced hydrocracking resulting in improved yield of heavy distillate oils from coal extract. The evidence is, however, not conclusive. Extended operations will permit a more rigorous proof of the presence or absence of radiation induced hydrocracking. The most positive effect of radiation observed is improved hydrofining. The removal of $N_2$, $O_2$, and S is more complete from the oils obtained from the radiation runs with coal extract. (auth)

**18461** (ORO-600) PREPARATION OF WOOD-PLASTIC COMBINATIONS USING GAMMA RADIATION TO INDUCE POLYMERIZATION; EFFECTS OF GAMMA RADIATION ON WOOD. Annual Report, November 1, 1961–October 31, 1962. James A. Kent, Anthony Winston, and William R. Boyle (West Virginia Univ., Morgantown. Engineering Experiment Station). Mar. 1, 1963. Contract AT(40-1)-2945. 52p.

Investigations are described concerning physical testing of wood-polymer combinations, impregnation of wood with monomers, chemical aspects of the operations such as polymerization rates, dose rate dependence of polymerization rates, effects of additives, and the effects of gamma radiation on certain physical properties of wood. Wood-polymer combinations based on white pine, birch, and white oak were prepared and tested. It was found in all cases that the proportional limit in compression and the hardness were increased over values for the base wood. The absorption of water by white pine-polymer combinations was substantially less than in the case of unmodified white pine, but the significance of this fact must await the results of additional work, including dimensional changes experienced during immersion in water. In the area of impregnation of wood with monomers and determination of polymer concentration gradient in the finished product, it was found that measurement of the densities of small samples taken from wood-polymer specimens afforded a reliable and comparatively easy method of determining polymer distribution. Additionally, the rapid sectioning and weighing of monomer-impregnated specimens provide a reasonably easy method for determining the extent of penetration. Investigations involving the chemical aspects of the problem are in part based on a fairly rapid, but approximate, method of determining in situ polymerization rates. Wafers of wood about $1\frac{1}{2}$ in. by $1\frac{1}{2}$ in. by up to $\frac{3}{4}$ in. thick are impregnated and irradiated to a selected dose. Unreacted monomer is removed by either subjecting the wafers to a vacuum or drying them in a current of air until constant weight is attained. This method, although not precise, provides data on the relative performance of chosen combinations under various conditions. Dose rate dependence of polymerization rates, total dose required for complete polymerization, and the effects of additives on dose requirements were studied. The work done on irradiation of wood shows that the penetrability to $N_2$ is slightly increased by irradiation and that the proportional limit in compression is somewhat decreased. Additional investigations are in progress. (auth)

**18462** RADIOISOTOPES IN SCIENCE AND INDUSTRY. Atomics, 16: No. 2, 20-6(Mar.-Apr. 1963).

Uses of radioisotopes are reviewed. Principles of isotope utilization are outlined. Production of radioisotopes, detection and measurement of radiation, effects of radiation on materials, effects of materials on radiation, and tracing atoms are discussed. (M.C.G.)

**18463** WORLD'S FIRST IN GAMMA IRRADIATION STERILIZATION. J. Grindrod. Atomics, 16: No. 2, 49-53(Mar.-Apr. 1963).

A gamma-irradiation sterilizing plant for treating plastic disposable syringes is described. The initial annual throughput is in the region of 10 million syringes, but this could be increased to 50 million. An automatic conveyor system moves cartons of syringes into the irradiation cell and past the cobalt source of gamma rays. The total exposure time is 3½ days but this time could be reduced with a stronger source. The $Co^{60}$ source is 50,000 c, which comes from the Calder Hall reactor. Strict bacteriological control is exercised by placing one syringe containing a highly contaminated strip inside one box in each batch irradiated. After sterilization, this is removed and tested for sterility. (M.C.G.)

**18464** A DEVICE FOR MEASURING THE DENSITY OF WOOD IN THE ANNUAL-RING AREA WITH THE AID OF BETA RAYS. E.-G. Niemann and W. Schweers (Technische Hochschule, Hanover). Atompraxis, 9: 99-103(Mar. 1963). (In German)

The construction of a device which makes it possible to measure the density of wood samples with a linear resolving power of as little as ±0.1 mm is described. The device uses a closely masked ray from a $Sr^{90}$ + $Y^{90}$ source and a scintillation counter which is especially adapted to this particular measurement problem. The maximum accuracy is ±0.02 $g/cm^3$. The possible accuracies obtainable with continuous measurement are discussed and examples of application are given. (auth)

**18465** INSTRUMENTS AND PROCESSES OF PRODUCTION CONTROL BY MEANS OF RADIOISOTOPES. EXAMPLES OF INDUSTRIAL REALIZATIONS. A. Loverdo. Energie Nucl., 5: 31-4(Jan.-Feb. 1963). (In French)

The operating principle of industrial control devices using gamma rays is discussed, and notably the detectors, regulators, and teleindicators of inaccessible levels. Some examples of the application of these control processes in the chemical, petrochemical, paper, and coal industries are then given while pointing out the results obtained and underlining the technical and economic advantages of the isotopic methods. (auth)

**18466** THE APPLICATION OF RADIOELEMENTS TO THE STUDY OF SOME PROBLEMS OF ELECTROMETALLURGY. R. Collée (Université, Liege). Ind. At., 6: 79-86 (1962). (In French)

The needs relative to the purity of materials prepared by the metallurgy industry become more and more severe, and it is essential to develop investigation and control methods more and more sensitive and precise. Among these methods, the utilization of radioisotopes is very important. Some original applications of radioisotopes and of gamma spectrometry to the study of electrometallurgical deposits are reported. (tr-auth)

**18467** POLAROGRAPHIC STUDIES ON STORAGE OF MEATS. PART XX. SYNERGISTIC EFFECT OF GAMMA-RAY IRRADIATION BY DOSAGES WITHIN $60 \times 10^4$ ROENTGENS AND 5°C STORAGE ON CHEMICAL CONSTITUENTS AND PROTEIN WAVES OF MEATS. Tetsujiro Obara and Yasokichi Ogasawara (Tokyo Univ.). Radioisotopes (Tokyo), 12: 27-44(Feb. 1963). (In Japanese)

An experiment on the storage life and changes in chemical components and protein waves of irradiated beeves, porks, and chickens during 5°C storage was presented. Each meat, 25g, was vacuum packed into a polyethylen-cellophane bag ($5.3 \times 10^{-2}$ mm thickness). Samples of each were irradiated with the following dosages: 0, $9.5 \times 10^4$, $20 \times 10^4$, $33 \times 10^4$, and $6 \times 10^4$ roentgens. Each sample was stored at 5°C for 120 days. Changes in chemical components and protein waves of each sample were estimated. Protein waves were estimated in a buffer (at 25°C) with the following composition: 0.001M $CoCl_2$, 0.1M $NH_4Cl$, and 0.2M $NH_4OH$. (C.E.S.)

**18468** USE OF RADIOACTIVE ISOTOPES IN THE INDUSTRY. Heinrich Fassbender (Technische Universität, Berlin). VDI (Ver. Deut. Ing.) Z., 105: 174-5(Feb. 1, 1963). (In German)

The industrial uses of radioisotopes for measurement of thickness or weight of unit area, for measurements of density and humidity, in technical radiochemistry, for investigations of the travel of sand, and as sources of energy are described. (M.C.G.)

**18469** ADVANCES IN TRACER METHODOLOGY. VOLUME 1. Proceedings of the Fifth Annual Symposium on Tracer Methodology, held on October 20, 1961, and Selected Papers from the First Four Annual Symposia and from Published Issues of "Atomlight." Seymour Rothchild, ed. New York, Plenum Press, 1963. 340p. $12.00.

A collection of 50 papers is presented, 14 of which have been previously abstracted in NSA. Separate abstracts have been prepared for the remaining 36. The papers are on the general subjects of the tritium gas exposure method, tritium labeling by other methods, radiation decomposition, liquid scintillation counting, gas counting, combustion methods, instrumentation, health physics, measuring turnover rates, tritium as a tracer isotope, tracer methodology, autoradiography, and clinical methodology. (M.P.G.)

**18470** EXPERIENCES WITH TRITIATED COMPOUNDS PREPARED BY EXPOSURE TO TRITIUM GAS. Charles Rosenblum and Henry T. Meriwether (Merck and Co., Inc., Rahway, N. J.). p.12-17 of "Advances in Tracer Methodology. Vol. 1." New York, Plenum Press, 1963.

The tritium labeling and subsequent testing of various solids are described. The compounds irradiated by exposure to curie quantities of tritium gas include a steroid, substituted aromatic compounds, a partly saturated polycyclic structure, a polybasic amino acid, a porphyrin-like structure, a sugar phosphate, and sucrose. No obvious relation between the specific activity of the samples and the exposure, number of hydrogen atoms, or particle size was found. The necessity for extreme caution before accepting a labeled material as an authentic tracer is emphasized. After purification of labeled compounds, a final multistage confirmatory test, such as column or paper chromatography or a countercurrent distribution, should be applied to assure the identification of the radioactivity with the parent compound. Trace compounds may be formed by hydrogenation of an unsaturated bond, or by radiochemical reaction, to account for the major part of the tritium. In many types of experiments, difficulties may be encountered, such as the slow exchange of tritium atoms in in vitro studies. Examples of difficulties encountered in labeling and using tritiated tracers are presented. (M.P.G.)

**18471** REACTION OF UNSATURATED ORGANIC COMPOUNDS WITH TRITIUM GAS. Herbert J. Dutton (Dept. of Agriculture, Peoria, Ill.) and Robert F. Nystrom. p.18-27 of "Advances in Tracer Methodology. Vol. 1." New York, Plenum Press, 1963.

A number of compounds representative of the more common structural types, such as methyl oleate, methyl linolenate, methyl sorbate, methyl stearolate, cyclohexene, isobutylene, cholesterol, and vitamin A acetate, were irradiated with tritium gas. It was found that tritium was incorporated by addition in methyl oleate, methyl lineoleate,

methyl linolenate, and vitamin A acetate. In cyclohexene, tritium was incorporated by 84% addition and 16% substitution. In isobutylene and cholesterol, tritium was incorporated approximately equally by addition and substitution. The procedures for purifying and analyzing the tritiated compounds are described, and results are presented. (M.P.G.)

**18472** SOME EXPERIENCES WITH LABELING NUCLEOTIDES. A. Markovitz, J. A. Cifonelli, and J. I. Gross (Univ. of Chicago). p.36-41 of "Advances in Tracer Methodology. Vol. 1." New York, Plenum Press, 1963.

Several uridine nucleotides were labeled by exposure to tritium gas. The irradiated nucleotides were UDP-glucuronic acid (UDPGA), UDP-N-acetylglucosamine (UDPAG), and UDP-N-acetylmuramic acid. The methods of repurification and results are described. It was found to be feasible to label UDPGA, UDPAG, and N-acetyl-glucosamine-1-phosphate by exposure to tritium gas. The specific activities obtained were adequate to study HA synthesis in Group A streptococci. (M.P.G.)

**18473** CORRELATION OF EFFICIENCY OF LABELING WITH CHEMICAL CONSTITUTION. Seymour Rothchild (New England Nuclear Corp., Boston). p.42-5 of "Advances in Tracer Methodology. Vol. 1." New York, Plenum Press, 1963.

Results of a questionnaire concerning labeling by exposure to tritium gas are summarized. The replies, grouped by chemical category, revealed a wide range of specific activities, showing that factors in addition to chemical constitution affect the tritium incorporation. Important factors are the proportion of labile H to stabile H, crystal size and structure, and the spatial distribution of the material during exposure. When the specific activity is divided by intensity of exposure (curie · days/gram), a measure of the "efficiency of labeling" is obtained. Sufficient data have not been obtained to predict the incorporation of tritium as a function of chemical category. (M.P.G.)

**18474** TRITIUM LABELING BY OTHER METHODS. Seymour Rothchild (New England Nuclear Corp., Boston). p.50-1 of "Advances in Tracer Methodology. Vol. 1." New York, Plenum Press, 1963.

Tritium-labeling techniques other than the gas-exposure method usually avoid the problem of radiation decomposition and enable one to obtain higher specific activities and specifically labeled positions. The preferred method is the reduction of a suitable precursor containing a double bond, carbonyl group, or some other readily reducible group. Other methods include exchange methods, hydrolytic methods, and isotopic synthetic methods. The question of lability of a tritium tag should be considered in the light of the conditions to which the compound will be subjected. High-specific-activity tritium-labeled compounds should be tested periodically for the formation of radioactive contaminants. (M.P.G.)

**18475** TRITIUM RECOIL LABELING OF LINSEED OIL. Jerry W. Harlan (Swift and Co. Research Labs., Chicago). p.52-5 of "Advances in Tracer Methodology. Vol. 1." New York, Plenum Press, 1963.

An experiment is described, which was performed to determine the mode of entry of recoil tritium into unsaturated fatty acid esters and the extent of chemical damage occurring in a vegetable oil during recoil labeling. The primary reaction in the labeling was the "random" replacement of H by tritium. The relatively high specific activities found in the methyl oleate and methyl linoleate indicate that some addition of tritium to the double bond occurred, although differences in capture efficiency or other factors could cause the high activities. The feasibility of labeling unsaturated vegetable oils by the tritium recoil method was demonstrated. (M.P.G.)

**18476** RADIATION SELF-DECOMPOSITION OF LABELED COMPOUNDS. Bert M. Tolbert (Univ. of Colorado, Boulder). p.64-8 of "Advances in Tracer Methodology. Vol. 1." New York, Plenum Press, 1963.

The radiation chemistry of organic compounds is briefly reviewed. The G(-M) values, defined as the number of molecules of a substance permanently altered or decomposed per 100 ev of ionizing radiation absorbed, are discussed, and a summary of known and estimated values for classes of compounds is given. Self-radiation changes in organic compounds are shown to depend on the specific activity of the sample, the average energy of the radiation, the half life of the radioactive isotope, the G(-M) value of the system, which depends on temperature, physical state, and nature of radiation, the fraction of energy absorbed by the compound, and other components in the compound, particularly oxygen. Methods for reducing self-decomposition in labeled organic compounds are discussed. (M.P.G.)

**18477** LIQUID SCINTILLATION COUNTING OF TRITIUM. James R. Arnold (Princeton Univ., N. J.). p.69-75 of "Advances in Tracer Methodology. Vol. 1." New York, Plenum Press, 1963.

The operation of scintillation counters is described, and the relative merits of various scintillation solutions are discussed. The phototubes and associated electronic circuits are reviewed, including the use of a pair of tubes in coincidence, pulse-height selection, and the operation of the Tri-Carb liquid-scintillation spectrometer. Sample materials that can be combined with scintillation solutions are also discussed, as well as the ultimate sensitivity of a tritium-counting system. (M.P.G.)

**18478** RECENT DEVELOPMENTS IN SIMULTANEOUS $C^{14}$ AND TRITIUM COUNTING. Jon J. Kabara, Norma R. Spafford, Marilynn A. McKendry, and Nancy L. Freeman (Univ. of Detroit). p.76-85 of "Advances in Tracer Methodology. Vol. 1." New York, Plenum Press, 1963.

The simultaneous use of $C^{14}$- and tritium-labeled compounds under identical experimental conditions has greatly extended the usefulness of tracer methodology in many fields of research. The development and improvement of double-label counting by the use of a liquid-scintillation counter are discussed. The operation of a liquid-scintillation spectrometer and the accuracy and precision that can be obtained in double-label counting are reported in some detail. A sample calculation of a double-labeled compound using the discriminator-ratio method is presented. (M.P.G.)

**18479** A NEW TECHNIQUE FOR COUNTING AQUEOUS SOLUTIONS IN THE LIQUID SCINTILLATION SPECTROMETER. Daniel Steinberg (National Heart Inst., Bethesda, Md.). p.93-105 of "Advances in Tracer Methodology. Vol. 1." New York, Plenum Press, 1963.

Various approaches to the problem of counting hydrophilic samples are briefly reviewed. A new method, which permits the direct counting of aqueous or alcoholic solutions, is described. A two-phase system is used, a solid phase consisting of a finely divided fluor, and a liquid phase containing the radioactive material to be assayed. A plastic scintillator containing diphenyloxazole or crystalline diphenyloxazole, anthracene, and certain other fluorescent solids can be used. The scintillator is made into a tightly packed bundle of filaments or into finely cut-up filaments

or "beads." The aqueous solution to be assayed is poured over the filaments or beads and counted in a liquid-scintillation spectrometer. Excellent reproducibility and efficiencies for $C^{14}$ of better than 50% were obtained using anthracene beads. The advantages of the two-phase system are that it should be completely general, the sample can be recovered unchanged, there is no need to concentrate or dry the sample, and for materials that have a high solubility in water, large amounts of sample can be counted. (M.P.G.)

**18480** LIQUID SCINTILLATION COUNTING OF TRITIUM IN SUSPENDED MATERIALS. J. F. Snell (Pfizer Therapeutic Inst., Maywood, N. J.). p.106-12 of "Advances in Tracer Methodology. Vol. 1." New York, Plenum Press, 1963.

Some of the directions being explored in an attempt to achieve rapid detection of tritium in animal tissues and other materials of biological origin are described. There is great doubt that a practical general procedure will be devised with present materials and techniques for the direct suspension counting of tritium in tissues by liquid scintillation. Suspension counting of plasma or serum is simpler and can be handled within reasonable degrees of precision for many biological studies. Procedures for preparing samples are described. (M.P.G.)

**18481** COUNTING $C^{14}O_2$ WITH A LIQUID SCINTILLATION COUNTER. Henry Jeffay (Univ. of Illinois, Chicago). p.113-14 of "Advances in Tracer Methodology. Vol. 1." New York, Plenum Press, 1963.

A $C^{14}$ compound or biological material containing $C^{14}$ is oxidized to $CO_2$-$C^{14}$, and the gas is trapped in an ethanolamine solution of ethylene glycol monomethyl ether. An aliquot of the carbonate solution is added to toluene containing a scintillator, cooled to 0°C, and counted in a liquid-scintillation spectrometer. Efficiencies up to 70% were realized. No correction for quenching is necessary when the quantity of ethanolamine and the ratio of the solvents are maintained constant. The observed counting rates have a linear relation to the absolute activity. (M.P.G.)

**18482** DETERMINATION OF RADIOACTIVE SULFUR IN BIOLOGICAL MATERIALS. Henry Jeffay (Univ. of Illinois, Chicago). p.119-20 of "Advances in Tracer Methodology. Vol. 1." New York, Plenum Press, 1963.

A relatively simple and accurate method is described for the determination of the $S^{35}$ content of a wide variety of substances. The sample to be counted is oxidized and dissolved in hot glycerol. An ethanol-dimethylformamide solution is added first, followed by a toluene scintillation solution. The sample is then counted in a liquid-scintillation spectrometer. A counting efficiency of 49% was obtained with this method. Nonradioactive materials in the samples did not interfere with the observed counting rate. A linear relation between the true counts and the observed counts of a standard $S^{35}$ solution was obtained over a wide range of activity. (M.P.G.)

**18483** SCINTILLATION COUNTING OF $C^{14}$-LABELED PAPER CHROMATOGRAMS. Robert Berner Loftfield (Massachusetts General Hospital, Boston). p.121-6 of "Advances in Tracer Methodology. Vol. 1." New York, Plenum Press, 1963.

The distribution of radioactivity in a paper chromatogram may be determined by immersing the paper in a scintillation mixture and using a liquid-scintillation counter. The difficulties encountered in using this system in the study of the enzyme-catalyzed activation of amino acids are described. Although the scintillation technique was much more efficient than the end-window counter, the orientation of the paper strip with respect to the phototube influenced the efficiency, and some results varied seriously with paper thickness and orientation. Rolling the paper into cylinders and adjusting the high voltage on the spectrometer minimized these difficulties. Other difficulties are mentioned, and a "standard" technique developed for this study is outlined. (M.P.G.)

**18484** SIMULTANEOUS MEASUREMENT OF $C^{14}$ AND $H^3$ DURING GAS-LIQUID CHROMATOGRAPHY. G. Popják, A. E. Lowe, and D. Moore (Hammersmith Hospital, London). p.127-46 of "Advances in Tracer Methodology. Vol. 1." New York, Plenum Press, 1963.

A method for continuously monitoring the effluent vapors from gas-liquid chromatographic columns is described. Gas is bubbled through a liquid-scintillator solution, and light pulses excited by condensed radioactive gases are detected by a photomultiplier tube. Two photomultipliers are used to take advantage of coincidence circuitry and to measure two isotopes simultaneously. The construction of the instrument and the layout of the electronic circuits are described in detail. Records obtained by the simultaneous counting of $C^{14}$ and $H^3$ in the analysis of $C^{14}$-fatty acid esters are presented. The method is ideally suited to the analysis of highly volatile radioactive substances, which would be impossible to study by paper chromatography without previous conversion to nonvolatile derivatives. (M.P.G.)

**18485** MONITORING GAS CHROMATOGRAPHY FOR $H^3$- AND $C^{14}$-LABELED COMPOUNDS BY LIQUID SCINTILLATION COUNTING. Herbert J. Dutton (Dept. of Agriculture, Peoria, Ill.). p.147-52 of "Advances in Tracer Methodology. Vol. 1." New York, Plenum Press, 1963.

Manual and automatic systems for the condensation of solutes from chromatographic gas streams in scintillator solvent are described. The relative merits of manual vs automatic operation are discussed. Monitoring with liquid-scintillation procedures has the principal advantage of sensitivity over the ion chamber. (M.P.G.)

**18486** APPLICATION OF WHOLE-BODY LIQUID SCINTILLATION COUNTERS TO PHARMACOLOGICAL STUDIES. Billy D. Rupe, William F. Bousquet, and John E. Christian (Purdue Univ., Lafayette, Ind.). p.153-9 of "Advances in Tracer Methodology. Vol. 1." New York, Plenum Press, 1963.

The application of whole-body counting to a study of the effects of various drugs on Na metabolism in the saline-hydrated rat was investigated. Five individual diuretic compounds were studied for their natruretic activity in rats. Results indicated that the natruretic activity of each compound could be detected by using whole-body counting techniques. In a study of the ability of the various diuretic compounds to concentrate Na in the urine, no direct relationship between natruretic and diuretic activity was found. However, the EDI value was shown to indicate the effect of the compounds on Na metabolism, both qualitatively and quantitatively. Whole-body liquid-scintillation counting is an effective tool in investigations of pharmacologically active substances, especially in cases where the drug in question exerts its major effect on a body constituent which is available in labeled form. (auth)

**18487** A COMPARISON OF IONIZATION-CHAMBER AND LIQUID-SCINTILLATION METHODS FOR MEASUREMENT OF BETA EMITTERS. V. P. Guinn and C. D. Wagner (Shell Development Co., Emeryville, Calif.). p.160-6

of "Advances in Tracer Methodology. Vol. 1." New York, Plenum Press, 1963.

The minimum sample specific activity that could be determined in a 30-min measurement time to a standard deviation of ±10% was calculated for 2 commercially available measuring systems, the Applied Physics Corp. vibrating-reed electrometer and the Packard Tri-Carb liquid scintillation spectrometer. Tritium and C-14 were used. The assumptions, calculations, and measurements are described. On the basis of concentration sensitivity, the 2 methods were found to have approximately equal sensitivity for small organic-tritium samples and water-tritium samples of any size. The liquid-scintillation method is considerably more sensitive for large organic-tritium samples and organic-$C^{14}$ samples and is also considerably faster. The coincidence liquid-scintillation unit is ~3 times as expensive as the vibrating-reed electrometer. Accuracy is comparable in the 2 methods. In order to handle any tritium or C-14 sample in the optimum manner, it is advisable to have both methods available. (M.P.G.)

**18488** TRITIUM MEASUREMENT USING IONIZATION CHAMBERS. Bert M. Tolbert (Univ. of Colorado, Boulder). p.167-77 of "Advances in Tracer Methodology. Vol. 1." New York, Plenum Press, 1963.

The design and use of electrometers, especially the vibrating-reed electrometer, to measure the small currents from ionization chambers are described. The ionization chambers used for the assay of radioactive gases are also described, and their many advantages are listed. Specific applications of the ionization chamber and electrometer in tritium assays are discussed, including monitoring of air for tritium, measuring tritium or $C^{14}$ activity in gas chromatography, assay of $H_2^3O$, and assay of organic compounds. The ionization chamber method for the assay of tritium is versatile and no longer very expensive. (M.P.G.)

**18489** GAS COUNTING OF TRITIUM. Charles V. Robinson (New England Center Hospital, Boston). p.178-82 of "Advances in Tracer Methodology. Vol. 1." New York, Plenum Press, 1963.

A summary of most of the papers published in English on nonscintillation methods for the assay of tritium is presented in tabular form with reference to the original paper. The conversions used in the various assay methods are diagrammed. Some brief remarks supplement the table. (M.P.G.)

**18490** VAPOR PHASE PROPORTIONAL COUNTING. Richard L. Wolfgang (Yale Univ., New Haven). p.183-4 of "Advances in Tracer Methodology. Vol. 1." New York, Plenum Press, 1963.

The design and use of proportional counters for assay of labeled gases are briefly reviewed. Metal proportional counters can also be used to assay directly vapors of high boiling point. The assay of tritium as $H_2^3O$ vapor in a heated proportional counter is a simple and accurate technique. The combination of temperature-programmed chromatography with heated counters permits rapid separation and accurate assay of very-high-boiling compounds. (M.P.G.)

**18491** RECENT ADVANCES IN INSTRUMENTATION. W. A. Higinbotham (Brookhaven National Lab., Upton, N. Y.). p.195-200 of "Advances in Tracer Methodology. Vol. 1." New York, Plenum Press, 1963. (BNL-5734)

Standard types of radiation detectors are briefly reviewed, and solid-state detectors are described. The advantages and disadvantages of transistors for detector circuits are discussed, along with the types of circuits in which transistors can be used. The trend to more complex and sophisticated equipment and to automation is mentioned, but the need to clean up and improve basic instruments is also pointed out. (M.P.G.)

**18492** TRITIUM HEALTH PHYSICS CONSIDERATIONS. John S. Handloser (Brookhaven National Lab., Upton, N. Y.). p.201-2 of "Advances in Tracer Methodology. Vol. 1." New York, Plenum Press, 1963.

The radioactive properties of tritium and the maximum permissible concentrations of tritiated water are tabulated. The toxicity of tritium gas and tritiated water is briefly discussed, and monitoring techniques are mentioned. (M.P.G.)

**18493** DESIGN AND ANALYSIS OF TRACER EXPERIMENTS. D. B. Zilversmit (Univ. of Tennessee, Memphis). p.203-4 of "Advances in Tracer Methodology. Vol. 1." New York, Plenum Press, 1963.

Definitions for specific activity, relative specific activity, pool size, steady state, turnover rate, fractional turnover rate, half-time, and turnover time are presented. The necessary steps in the design of an isotope experiment are outlined, and references that discuss various methods of design and analysis are listed. (M.P.G.)

**18494** DESIGN AND ANALYSIS OF TRACER EXPERIMENTS—BIOCHEMICAL ASPECTS. Martin D. Kamen (Brandeis Univ., Waltham, Mass.). p.205-9 of "Advances in Tracer Methodology. Vol. 1." New York, Plenum Press, 1963.

Examples of the application of isotopic tracer techniques to biology at the biochemical level including research in cholesterol synthesis, the utilization of acetate and glycine carbon for synthesis of hemin, the demonstration of phosphoglyceric acid as the first detectable product of the $CO_2$ fixation in green-plant photosynthesis, and the demonstration of asymmetric synthesis based on the Ogston hypothesis. Problems remaining in the biosynthetic mechanisms involving small molecules are considerably more complicated, such as enzyme-catalyzed reactions for the fixation of $CO_2$ in photosynthesis. Approaches to this problem are discussed. Methods for distinguishing components in mixtures of macromolecules are not adequate to permit full utilization of tracer techniques. However, the biosynthesis of the macromolecule DNA was made possible by a combination of tracer methodology and enzymology, indicating that tracer techniques can be extended to problems such as the biosynthesis of protein and other macromolecules. (M.P.G.)

**18495** EXPERIMENTAL DESIGN OF TURNOVER MEASUREMENT STUDIES IN THE UNSTEADY STATE: BIOSYNTHESIS OF MACROMOLECULES. John M. Reiner (Emory Univ., Atlanta). p.210-16 of "Advances in Tracer Methodology. Vol. 1." New York, Plenum Press, 1963.

The contribution of the measurement of turnover rates to questions about the biosynthesis of macromolecules is investigated. An experiment to study problems involved in the measurement of amino acid incorporation in the absence of net synthesis is outlined. An experimental approach is also suggested to study the problem of whether the biosynthesis of proteins involves a template mechanism in which the entire molecule is assembled at a single site or whether it proceeds by the stepwise building of intermediates. Analysis of the suggested experiments indicates that a meaningful measure of turnover or synthesis can be obtained, even for macromolecules, but classical approaches are still necessary to learn about mechanisms. Tracer methods supplement but do not replace classical methods. (M.P.G.)

**18496** MEASURING TURNOVER RATES IN THE NON-STEADY STATE. Henry Jeffay (Univ. of Illinois, Chicago). p.217-21 of "Advances in Tracer Methodology. Vol. 1." New York, Plenum Press, 1963.

The 3 basic approaches to the measurement of turnover rates, whether in the steady or nonsteady state, are: the injection of a labeled precursor; maintaining the labeled precursor at a constant specific activity; and using the labeled product. The advantages and disadvantages of each method are described. In each case, a simple measure of the specific activity of the product at various times will not give the turnover rate. Data on the pool size and rate of change in specific activity of precursor and product must be known before reasonable approximations of the turnover rate can be obtained. (M.P.G.)

**18497** TRITIUM IN BIOCHEMICAL STUDIES. Maxwell L. Eidinoff (Sloan-Kettering Inst. for Cancer Research, New York). p.222-6 of "Advances in Tracer Methodology. Vol. 1." New York, Plenum Press, 1963.

The use of tritium instead of deuterium in biochemical systems is discussed. Types of experiments in which double labeling with tritium and $C^{14}$ is desirable or undesirable are mentioned. Information on the separation or fractionation of the hydrogen isotopes in biochemical systems is excerpted from a previous report. (M.P.G.)

**18498** SPECIAL FEATURES OF TRITIUM AS A TRACER IN INDUSTRIAL RESEARCH. V. P. Guinn (Shell Development Co., Emeryville, Calif.). p.227-33 of "Advances in Tracer Methodology. Vol. 1." New York, Plenum Press, 1963.

The important properties of tritium are summarized. Three tritium counting methods, liquid scintillation, ionization chamber, and gas counting, are discussed in terms of their concentration sensitivities. Examples of high-dilution tracer studies using tritium are presented, including water- and gas-flow studies and lubricating-oil consumption-rate studies. (M.P.G.)

**18499** SOME USES OF TRITIUM-LABELED COMPOUNDS IN PHARMACEUTICAL RESEARCH. J. F. Snell (Pfizer Therapeutic Inst., Maywood, N. J.). p.234-46 of "Advances in Tracer Methodology. Vol. 1." New York, Plenum Press, 1963.

Precautions which must be taken in interpreting data obtained with tritium-labeled drugs are summarized. The investigation of the chemical and biological stability of new drugs, the drugs' translocation and distribution within the body fluids and organs as a function of time, and their biochemical mode of action is reported for biologically labeled $C^{14}$-oxytetracycline, 7-tritio-tetracycline, oleandomycin labeled by exposure to tritium gas, and Atarax. (M.P.G.)

**18500** METABOLISM OF DL-EPINEPHRINE-7-$H^3$ D-BITARTRATE. Elwood H. LaBrosse (National Inst. of Mental Health, Bethesda, Md.). p.247-56 of "Advances in Tracer Methodology. Vol. 1." New York, Plenum Press, 1963.

The metabolism of dl-epinephrine in man was studied by administering i.v. 1 mg of tritium-labeled epinephrine in isotonic saline to 6 human males and collecting their urine for 48 hrs. The analysis of the specimens is described and possible routes of metabolism are diagrammed. The results indicate that 0-methylation to metanephrine is the principal route of metabolism of epinephrine in the human. A more complete scheme for the metabolism of epinephrine is presented in an addendum, but subsequent experiments do not change the original conclusion. (M.P.G.)

**18501** APPLICATION OF TRITIUM IN THE DETERMINATION OF GIBBERELLINS. W. E. Baumgartner, L. Lazer, and A. Dalziel (Abbott Labs., North Chicago, Ill.). p.257-62 of "Advances in Tracer Methodology. Vol. 1." New York, Plenum Press, 1963.

The use of tracers in development work on gibberellins is described. The two isomers of interest are gibberellic acid, $C_{19}H_{22}O_6$ (GA), and its dihydro derivative, gibberellin $A_1$, $C_{19}H_{24}O_6$ (HGA). The determination of the ratio between GA and HGA in fermentation liquors is simplified by the use of tritium labeling. Methods using $H_2^3O$ exchange procedures or $C^{14}$-labeled diazomethane for the determination of the absolute concentration of GA and HGA in fermentation and process liquors are described. Double labeling techniques are used for the determination of very small quantities of GA or HGA in plant tissues, and the use of tritium-labeled GA in combination with liquid-scintillation counting is very useful in determining process data. (M.P.G.)

**18502** NEW DEVELOPMENTS IN THE USE OF RADIOISOTOPES IN RESERVOIR ENGINEERING. Donald R. Carr (Isotopes, Inc., Westwood, N. J.). p.263-4 of "Advances in Tracer Methodology. Vol. 1." New York, Plenum Press, 1963.

The advantages of tritium over other tracers for oil production and reservoir exploration are listed. In a "5-spot" technique, water or gas forced down 4 injection wells will force oil to the site of the production well, where it is removed. Different tracers in each injection well indicate which wells are effective. Tritium, $CH_4^3$, $C_2H_6^3$, $C^{14}H_4$, $C_2^{14}H_6$, and $Kr^{85}$ are used in this technique. If the flooding fluid is water, tritiated water is the ideal tracer. Labeled gases are used in underground storage reservoirs to measure the size of the reservoir and to detect leaks. (M.P.G.)

**18503** USE OF RADIOISOTOPES IN STEROID METHODOLOGY. Ralph E. Peterson (Cornell Univ., New York). p.265-73 of "Advances in Tracer Methodology. Vol. 1." New York, Plenum Press, 1963.

When conventional isotope-dilution methods are not applicable to the determination of steroids in biological mixtures, derivatives of the steroids can be formed. The labeled derivatives can then be used for analysis by isotope-derivative or dilution-derivative methods. The advantages of the derivative methods are discussed. The preparation of tritium-labeled steroids by exposure to tritium gas is described, as is tritium and $C^{14}$ counting with a liquid-scintillation spectrometer. The procedures for double-isotope-derivative assay of labeled and unlabeled steroids and for double-isotope-dilution-derivative assay are detailed. (M.P.G.)

**18504** AUTORADIOGRAPHY WITH TRITIUM. Walter L. Hughes (Brookhaven National Lab., Upton, N. Y.). p.291-4 of "Advances in Tracer Methodology. Vol. 1." New York, Plenum Press, 1963.

It is shown that good autoradiographic resolution can be obtained with tritium, since essentially all of the silver grains in the photographic emulsion that are activated by tritium lie within a micron of the labeled locus. The specific activities of labeled compounds required for autoradiography are estimated. A method for labeling thymidine with tritium by catalytic exchange on reduced palladium black in acetic acid is described. Tritiated thymidine has proved useful in studying the mechanism of DNA synthesis and in relating the chronology of other events within the cells to DNA synthesis. Possible complications produced by radiation from the incorporated tritium are pointed out. (M.P.G.)

**18505** SOME USES OF TRITIUM IN AUTORADIOGRAPHY. J. Herbert Taylor (Columbia Univ., New York). p.295-301 of "Advances in Tracer Methodology. Vol. 1." New York, Plenum Press, 1963.

The advantages of using tritium in autoradiography are summarized, along with some of the difficulties that must be overcome. Several experiments using tritiated nucleosides are discussed, including the study of DNA in chromosomes and the timing of events in the mitotic cycle using thymidine-$H^3$. Cytidine-$H^3$, uridine-$H^3$, adenosine-$H^3$, and deoxycytidine-$H^3$ provide additional labels for the study of nucleic acid metabolism, and some studies using these nucleosides are briefly described. Tritiated amino acids are used in experiments such as the study of the distribution of labeled proteins in chromosomes during duplication. (M.P.G.)

**18506** METHOD OF VULCANIZING RUBBER. Wendell V. Smith and Verne G. Simpson (to United States Rubber Co.). U. S. Patent 3,084,115. Apr. 2, 1963. Filed Jan. 16, 1959.

A method is given for increasing the amount of radioinduced vulcanization of a rubber composition. The method comprises mixing 1.5 to 15 parts of an acrylate, diacrylate, or dimethacrylate compound with 100 parts of rubber and subjecting the mixture to a dosage of 4 to 40 watt-hours. Various compounds which may be used as the additive are given. (D.L.C.)

**18507** METHOD OF DETERMINING PIPELINE LEAKAGE. William A. Wilson and George S. John (to Standard Oil Co.). U. S. Patent 3,084,259. Apr. 2, 1963. Filed Aug. 24, 1959.

A radioactive tracer method is described for testing for leaks in a section of conduit. The method comprises establishing at least two spaced-apart injections of the tracer in the fluid of the conduit section, maintaining the fluid at a preselected pressure under static flow conditions, resuming flow of the fluid in the conduit, and locating the leak by monitoring the spacing of the injections. (D.L.C.)

# INSTRUMENTS AND INSTRUMENTATION

## General and Miscellaneous

*Refer also to abstract 17649.*

**18508** (AFSWC-TDR-62-63) TRANSIENT RADIATION EFFECTS IN PRESSURE TRANSDUCERS. R. A. Poll and V. A. J. van Lint (General Atomic Div., General Dynamics Corp., San Diego, Calif.). June 1962. Contract AF29 (601)-4953. 72p. (AD-283993)

The performance of two types of pressure transducers in a radiation environment was evaluated by an experimental program. The devices were a quartz piezoelectric crystal assembly and a strain gauge transducer. The most important perturbations of these transducers by a short pulse of radiation are the emission and absorption of secondary electrons by parts of the device and the conductivity of insulating materials, including quartz, cable connectors and cables. The experimentally measured results can be applied to evaluate the spurious signals and the perturbation of pressure-induced signals in a specified pulse radiation environment. (auth)

**18509** (BNL-6906) HALL PROBE REGULATION OF EXPERIMENTAL POWER SUPPLIES. G. S. Levine (Brookhaven National Lab., Upton, N. Y.). Apr. 4, 1962. Contract [AT(30-2)-Gen-16]. 4p.

The Hall mode of operation utilizes a signal derived from the magnetic field of an experimental magnet to provide the power supply regulator with the information necessary for it to regulate the magnet current. Regulation of the field to 0.1% is possible with the Hall probes and regulators used at the Cosmotron. The Hall Effect is a phenomenon whereby the voltage developed across a semiconductor or metal is a function of the current through the material and the magnetic field intensity perpendicular to the direction of current flow. Circuitry is required to maintain the probe at a constant temperature and to maintain a constant Hall current. The output Hall voltage is linearly related to the magnetic field with its absolute value being determined by the level of the Hall current. Instructions for installation and operation of the Hall probes are given. (H.G.G.)

**18510** (CERN-63-3) PROCEEDINGS [ON] 1962 EASTER SCHOOL FOR PHYSICISTS, USING THE NUCLEAR EMULSION TECHNIQUE IN CONJUNCTION WITH THE CERN PROTON SYNCHROTRON AND SYNCHROCYCLOTRON, HELD AT ST. CERGUE, APRIL 8-18, 1962. N. Doble and W. O. Lock, eds. (European Organization for Nuclear Research, Geneva). Feb. 6, 1963. 394p.

An introductory lecture is presented to state the purposes of the school and to provide background material for the information presented in subsequent lectures. The CERN synchrotron, its targets, and beam transport are considered. General problems of emulsion irradiations, handling, and processing are included along with measurement techniques. Production of high magnetic fields by the CERN pulsed magnet apparatus, typical emulsion experiments, and the organization of emulsion experiments at CERN are outlined. Separate abstracts are prepared for 24 papers. (C.E.S.)

**18511** (CERN-63-3(p.1-15)) INTRODUCTORY TALK. K. Gottstein (Max-Planck-Institut fur Physik, Munich).

The purposes of the school are outlined. Special features of the emulsion, track chamber, and electronics techniques are compared and the fields in which each has particular value are discussed. Specific examples of experiments that are best suited for nuclear emulsions are included. (C.E.S.)

**18512** (CERN-63-3(p.17-25)) THE CERN PROTON SYNCHROTRON AND ITS TARGETS. W. Richter (European Organization for Nuclear Research, Geneva).

The general layout of the proton synchrotron (PS) is given. The CERN PS accelerates protons to momenta between 10 and 28 Bev/c at repetition rates of 1 and 5 seconds, respectively. At top energy there are about $2 \times 10^{\text{e}}$ protons accelerated per cycle and directed onto a target. The machine, experimental areas, target positions, target mechanism, and target heads are described. The machine cycle, programming, and sharing and the beam behavior during target operation are outlined. The descriptions are supplemented by 13 diagrams. (C.E.S.)

**18513** (CERN-63-3(p.27-47)) METHODS TO CALCULATE BEAM TRANSPORT SYSTEMS. B. de Raad (European Organization for Nuclear Research, Geneva).

Equations and general considerations that were found useful in designing secondary beams for the CERN proton synchrotron are presented. (C.E.S.)

**18514** (CERN-63-3(p.49-68)) A SIMPLE EXAMPLE IN BEAM OPTICS. W. Toner (European Organization for Nuclear Research, Genvea).

To illustrate the theory developed in the previous lecture, a beam with two successive deflections is considered in detail. Calculations of lens strengths and trajectories in the first and second stage of the beam are given. Phase-space diagrams to illustrate momentum selection are considered. Chromatic aberration and dispersion, finite-length apertures, estimation of image sizes, wedge absorbers, and sources of unsharpness in images are discussed. Two appendices that facilitate writing data tapes and contain the complete data for the beam calculated by the computer program are included. (C.E.S.)

**18515** (CERN-63-3(p.69-79)) SOME PROPERTIES OF BEAMS WITH ELECTROSTATIC SEPARATORS. S. van der Meer (European Organization for Nuclear Research, Geneva).

Electrostatic separators for high-energy purposes are usually large and are mostly used near the limit of electrical breakdown. A simple arrangement for separating particles is shown. General properties of separated beams are considered. The description of a separated antiproton beam is included. (C.E.S.)

**18516** (CERN-63-3(p.81-93)) BEAMS OF PARTICLES OF FINITE LIFETIME. E. Malamud (European Organization for Nuclear Research, Geneva).

A theoretical limitation is added to complete a discussion of beam transport. Beams of particles of finite lifetime are considered. The previously developed theory is applied to a beam of mesons ($K^-$) with mean life $\tau = 1.2 \times 10^{-8}$ sec. A table of miscellaneous facts concerning magnets and figures on the standard CERN magnets is included. (C.E.S.)

**18517** (CERN-63-3(p.95-102)) GENERAL PROBLEMS OF EMULSION IRRADIATIONS. J. C. Combe (European Organization for Nuclear Research, Geneva).

General problems connected with exposing emulsion stacks and the way in which they are generally solved are

described. The problems include intensity measurements, angular distribution of the beam, and geographical distribution of particles inside the beam. Positioning and safety of the stack, determination of certain characteristic values concerning the stack, and the intensity of the exposure are also considered. (C.E.S.)

**18518** (CERN-63-3(p.103-10)) TECHNICAL PROBLEMS OF EMULSION IRRADIATIONS. M. A. Roberts (European Organization for Nuclear Research, Geneva).

The type of equipment necessary to make emulsion exposures to beams from the proton synchrotron is described. The problem of lining up the apparatus to optical accuracy and the determination of the shape and actual position of the particle beam are discussed. (C.E.S.)

**18519** (CERN-63-3(p.111-27)) USE OF TARGET IN SECONDARY PARTICLE BEAMS. J. C. Combe (European Organization for Nuclear Research, Geneva).

A general review is made of the problems posed by the construction and use of targets for the study of elementary particle interactions. (C.E.S.)

**18520** (CERN-63-3(p.129-50)) THE PROPERTIES OF PHOTOGRAPHIC EMULSIONS. E. Dahl-Jensen (Institut for Teoretisk Fysik, Copenhagen).

The characteristics of photographic emulsions are compared to those of nuclear emulsions. The mechanism of exposures and fading is discussed. Methods of hypersensitization of nuclear emulsions are included. Ilford, Eastman Kodak, Gevaert, and Agfa emulsions are described and compared with the Russian NIKFI-R and the Japanese FUJI ET-7A. The heterogeneous and homogeneous loading of nuclear emulsions are also considered. (C.E.S.)

**18521** (CERN-63-3(p.155-65)) THE HANDLING OF EMULSIONS. M. A. Roberts (European Organization for Nuclear Research, Geneva).

Methods for the handling of nuclear emulsions are presented. Techniques of milling, mounting, demounting, marking, and accurate thickness and density measurements are discussed. Procedures for gridding and transport of undeveloped emulsions are included. (C.E.S.)

**18522** (CERN-63-3(P.169-97)) DISCUSSION ON THE PROCESSING OF NUCLEAR EMULSIONS. E. Dahl-Jensen (Institut for Teoretisk Fysik, Copenhagen); K. Gottstein (Max-Planck-Institut für Physik, Munich); H. Heckman (California. Univ., Berkeley. Lawrence Radiation Lab.); M. W. Teucher (Germany. Physikalisches Staatsinstitut, Hamburg); and G. Vanderhaeghe (European Organization for Nuclear Research, Geneva).

Methods of processing nuclear emulsions and variations of these methods are discussed. (C.E.S.)

**18523** (CERN-63-3(p.199-209)) MICROSCOPES. G. Vanderhaeghe (European Organization for Nuclear Research, Geneva).

A brief survey of the generally available and commonly used equipment for nuclear emulsion microscopy is given. Comments and recommendations dictated by practice are added. (C.E.S.)

**18524** (CERN-63-3(p.211-19)) MEASUREMENT OF CURVATURE IN A MAGNETIC FIELD. W. M. Gibson (Bristol Univ., England. H. H. Wills Physics Lab.).

Elementary theory for the measurement of momentum and charge by magnetic deflection in emulsion is presented. Theory for determining the radius of curvature, curvature, and scattering distance are applied to obtain actual measurements of these values for mesons ($\pi$) and protons in emulsions. Corrections for distortion are also included. (C.E.S.)

**18525** (CERN-63-3(p.221-4)) AUTOMATION OF MICROSCOPE WORK. W. M. Gibson (Bristol Univ., England. H. H. Wills Physics Lab.).

A discussion of methods for speeding up emulsion work by mechanization is given. A summary of available equipment for mechanization is presented. (C.E.S.)

**18526** (CERN-63-3(p.225-44)) GRAIN DENSITY AND IONIZATION LOSS IN EMULSION. D. H. Perkins (Bristol Univ., England. H. H. Wills Physics Lab.).

The study of the distribution of grains in emulsion tracks is part of a more general problem of fluctuations, and can equally well be applied to tracks in bubble chambers, dead-time of counters, and so on. (auth)

**18527** (CERN-63-3(p.245-74)) SCATTERING MEASUREMENTS IN EMULSION. D. H. Perkins (Bristol Univ., England. H. H. Wills Physics Lab.).

Theories are developed for single and multiple scattering in nuclear emulsions. Experimental measurements of scattering are discussed to ensure accurate readings. Statistical errors are considered. The form of distortion is described, and methods of elimination of distortion from scattering measurements are outlined. (C.E.S.)

**18528** (CERN-63-3(p.275-96)) SCANNING METHODS AND STATISTICS OF EMULSION MEASUREMENTS. E. H. S. Burhop (London. Univ. University Coll.).

Two types of scanning methods are described, area scan and line scan. Bias on the part of the scanner is considered as well as the efficiency of scanning and optimum scanning speed. Statistical methods are discussed for the uncertainty due to the limited size of the sample. The Poisson and Gaussian distributions are considered for the elimination of this uncertainty. (C.E.S.)

**18529** (CERN-63-3(p.297-314)) THE CERN PULSED MAGNET APPARATUS. L. Hoffmann (European Organization for Nuclear Research, Geneva).

The main principles and characteristics of pulsed fields are discussed since this method can produce high fields over a sufficient volume. A short review of different magnet types is given. The application of high fields to emulsions and the expected accuracy of measurements based on the field characteristics are considered. (C.E.S.)

**18530** (CERN-63-3(p.315-23)) K-MESON PHYSICS. E. H. S. Burhop (London. Univ. University Coll.).

Advantageous features peculiar to nuclear emulsions are considered, and meson ($K^-$) experiments that exploit these advantages are discussed. (C.E.S.)

**18531** (CERN-63-3(p.325-37)) THE DETERMINATION OF THE LIFETIME OF THE $\pi^0$ MESON. H. Heckman (California. Univ., Berkeley. Lawrence Radiation Lab.).

Measurements and techniques for a nuclear emulsion experiment to determine the meson ($\pi^0$) lifetime are discussed. (C.E.S.)

**18532** (CERN-63-3(p.339-59)) SMALL-ANGLE SCATTERING. H. Winzeler (Bern. Universität. Physikalisches Institut).

Problems of small-angle scattering are considered. Special properties and limitations of counters, bubble chambers, and emulsions are discussed with respect to the study of small-angle scattering. The discussion is limited to laboratory angles above 1.5 mrad and elastic scattering. (C.E.S.)

**18533** (CERN-63-3(p.361-75)) MEASUREMENT OF THE MAGNETIC MOMENT OF HYPERONS. Ph. Rosselet (Lausanne, Switzerland. Université. Ecole Polytechnique. Laboratoire de Recherches Nucléaires).

Theory and experimental procedures for measuring the magnetic moment of hyperons are considered. The theory is based on the fact that when a beam of particles crosses a magnetic field, the direction of polarization of these particles turns around a given axis at a velocity proportional to their magnetic moment. Initial, final, and precession of the polarization in a magnetic field are theorized. Measurement of the angle of precession and a description of actual experiments are included. (C.E.S.)

**18534** (CERN-63-3(p.i-iii)) AN IBM PROGRAMME FOR KINEMATIC ANALYSIS OF MESIC AND NON-MESIC DECAYS OF HYPERNUCLEI. K. Koelbig and M. Nikolić (European Organization for Nuclear Research, Geneva).

CERN has at its disposal an IBM program for the kinematic analysis of hypernuclei that represents an improved version of the one used by the Berne group. The program is designed for the complete analysis of nonmesic and mesic decays of hyperfragments at rest. The upper limit for the charge of the hyperfragments to be analyzed is eight in the case of the nonmesic and $\pi^0$ decays and seven in the case of $\pi^-$ decays. (C.E.S.)

**18535** (IDO-16836) THERMOCOUPLE ATTACHMENT FOR THE INITIAL EOCR CORE. D. R. Conkling and T. L. Rasmussen (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). Feb. 14, 1963. Contract AT(10-1)-205. 39p.

Procedures used to formulate and evaluate a method of attaching thermocouples for instrumenting fuel plates of the EOCR are presented. The selection of high-temperature brazing as the method of surface-attaching thermocouples was based on testing that proved that braze-attached thermocouples could be calibrated and that they possess the physical strength required for reactor application. Non-destructive means can be used to obtain numerical factors necessary for correction of deviated thermocouple readings caused by variation in physical attachment. (auth)

**18536** (ISS-62/40) UN CIRCUITO PER LA STABILIZZAZIONE DELLA AMPLIFICAZIONE DI UN FOTOMOLTIPLICATORE. (A Photomultiplier Gain Stabilization Circuit). M. Ageno and C. Felici (Italy. Instituto Superiore di Sanità, Rome). Dec. 3, 1962. 16p.

A simple method is described for the gain stabilization of a photomultiplier in which the stabilization system does not interfere with the fast pulse spectrum to be measured. The functioning principle consists in sending a low frequency (75 Hz) and low intensity light pulse, which gives a modulation of the photomultiplier thermic noise, on the photocathode together with the scintillation light. The modulation frequency is then selected by a special filter. The signal in this way obtained is used to trigger a feedback circuit, which gets the photomultiplier gain constant, suitably varying its voltage. (auth)

**18537** (KR-37) POLARIZED THERMAL NEUTRON BEAMS OBTAINED FROM MAGNETIZED MIRRORS AND SINGLE CRYSTALS OF MAGNETITE AND COBALT–IRON ALLOY. O. Steinsvoll, K. Abrahams, and T. Riste (Norway. Institutt for Atomenergi, Kjeller). Sept. 1962. 121p.

The results of experiments with an iron-chromium mirror are summarized. The polarization of the reflected beam from the magnetized mirror was analyzed by crystals of magnetite and cobalt-iron. Thus the performance of the mirror could be tested for different neutron wavelengths. The maximum polarization observed is about 80 per cent, but the average value in the beam is around 60 per cent. The degree of saturation of the mirror was measured directly and has in addition been derived from the neutron data. At maximum strength of the magnetizing current the results indicate thta $B/B_{sat} = 0.65 \pm 0.08$. The neutron flux at 334 cm distance from the nearest mirror edge was measured by activation of a NaI(Tl) crystal. The value obtained was $(1.7 \pm 0.2) \cdot 10^5$ n cm$^{-2}$ sec$^{-1}$. The source block of neutrons is located at a position where the neutron flux is $6 \cdot 10^{11}$ n cm$^{-2}$ sec$^{-1}$. A simple and versatile system of magnetic guide fields was developed. This system permits turning the spin of the travelling neutrons through any desired angle in space, reversal of the direction of the guide field with respect to the neutron spin. All this was achieved without any detectable depolarization of the neutrons. The possible applications of polarized thermal neutrons in nuclear and solid state physics are reviewed. Theory of neutron polarization and performance of the auxiliary equipment needed in work with polarized neutrons is reviewed. 72 references. (auth)

**18538** (LADC-5407) LINEAR TIME BASE PRECISION AND THE COMPOUND SWEEP CONCEPT (thesis). William W. Steger (Los Alamos Scientific Lab., N. Mex.). 1962. Contract W-7405-Eng-36. 94p.

A monograph on general precision criteria for feedback linear time base circuits is presented. The linearity and stability performance of these devices is evaluated in terms of deviation from an ideal ramp function. Attempts are made to provide a complete reference for the most commonly encountered aspects of time base precision with attention being centered on what could be called the "low frequency" case, which most often is valid in applications requiring a high precision time base. The subject is developed in a number of progressive, cumulative stages. The end products at each stage of the analysis are the equations describing linearity or stability performance for certain time base forms subject to given component idealizations. As the analysis progresses, the component idealizations are successively removed, and the resultant equations seem to change accordingly. The discussion begins with a qualitative statement of the problem and the ideas to be analyzed; the motivation and objectives are outlined. Symbology and terminology to be used are defined by usage in deriving a model for sweep linearity evaluation. The classical Bootstrap and Miller sweep circuits are treated for the usual ideal component assumptions in order to provide continuity and foundation for the more complicated cases to follow. It is seen that these circuits may be reduced to a canonic equivalent circuit for performance study. A semi-quantitative discussion compares Bootstrap and Miller sweep circuit performance. The present state of voltage comparator precision development is examined, and a conclusion drawn that time modulation systems can justifiably call for linear time base precision much better than that obtainable in the simplest sweep circuit configurations. The usual general methods for improving Miller and Bootstrap sweep linearity are briefly discussed. Circuit techniques for obtaining high open loop gain in simple configuration sweep amplifiers are mentioned in relation to the general linearity improvement methods discussed. The apparently original technique of "bootstrapping" the load resistor is introduced as another device to improve sweep linearity. To obtain greater linearity improvements in still reasonably simple circuit configurations, the general concept of a Miller integrator sweep circuit fed charging current by a current regulator is deduced. Performance equations are derived for a "compound" time base and comparison made

to basic Bootstrap and Miller circuit performance. The precision effects of leakage current, amplifier output impedance, and parasitic shunt impedances are then studied for all sweep circuit forms. Finally, the effects of component instabilities are derived using the total differential approximation. (auth)

**18539** (LADC-5541) GAMMA-RAY SENSITIVE IMAGE INTENSIFIER TUBE WITH CLOSED CIRCUIT VISUAL DISPLAY. N. G. Wilson (Los Alamos Scientific Lab., N. Mex.). [nd]. Contract W-7405-eng-36. 29p.

Descriptions are presented of an x ray system capable of producing detailed images of the motion occurring in experimental apparatuses used in development of dynamic molten Pu systems. The system is able to produce x ray pictures via television in a continuous manner and while the quality does not approach that of conventional radiographs, it will produce usable radiographs which can be obtained in no other way. (J.R.D.)

**18540** (NIRL/R/21) A NEW TYPE OF ACCELERATING TUBE FOR ELECTROSTATIC GENERATORS. W. D. Allen (Gt. Brit. National Inst. for Research in Nuclear Science. Rutherford High Energy Lab., Chilton, Berks, England). Oct. 1962. 14p.

Many electrostatic generators are limited in their performance by electron currents which, by the release of x rays and ionization in the high pressure envelopes, cause heavy loading on the terminal. In the tube described below, this loading is minimized by setting the electrodes at a slight angle to the normal, so that charged particles originating at the electrodes are relatively strongly deflected, while for fast particles incident at the center of the electrode, the deflection is small and the net deflection of a series of electrodes is zero. Tubes made in this way were tested in the Oxford Project test machine at Harwell and the 6 mv electrostatic generator at Manchester. Results to date show that the high energy performance is considerably improved over standard tubes: the Harwell machine carried an electron beam at 4 mv negative over a 6-ft length, while the Manchester tube operated at 6 mv with little conditioning and with x-ray yields down by a factor of at least ten over conventional tubes. Troubles with the tube arose from the mechanism whereby the secondary particles are suppressed. Both machines showed a small but appreciable "wobble" of the beam, of between $\pm 1/16$ in. to $\pm 1/8$ in. This was attributed to the inductive effect of the belt on sets of plates as irregular charge distribution was carried through the stack. In the Manchester machine, in which the column current was of the same order and sometimes considerably less than the beam current, pronounced sideways shifts (up to $1/2$ in.) of the beam were also observed. An account of the principles of the tube design, of its method of construction, and a report to date of tests with the tube are described. (auth)

**18541** (RT/EL(62)18) TUNNEL DIODE AND COMMON-BASE TRANSISTOR CIRCUIT IN FAST ELECTRONICS AND FAST DECADE TRANSISTOR SCALERS. F. Bartoccini, A. Serra (Italy. Comitato Nazionale per l'Energia Nucleare. Laboratorio di Elettronica, Rome); I. Brčić, and V. Radeka (Institut "Rudjer Bošković," Zagreb). Dec. 1962. 39p.

Tunnel diodes and common-base transistor circuits were investigated with respect to their use in fast nuclear electronics. The parallel and series-parallel combinations of the tunnel diode and common-base transistors are found to be extremely useful basic logic elements for scalers, discriminators and coincidences. Based on this investigation a 200 Mc/sec bistable circuit, a pulse shaper and discriminator with resolution of 8 nsec and a coincidence circuit with resolution of 4 nsec were developed. Two transistor scaling decades for 30 and 10 Mc/sec were developed. The experimental results of this work and the above mentioned circuit are presented. (auth)

**18542** (SCTM-21-63(24)) AN AIR-BATH COMPARATOR FOR LIQUID-IN-GLASS THERMOMETERS. R. B. Foster, Jr. (Sandia Corp., Albuquerque, N. Mex.). Feb. 1963. Contract [AT(29-1)-789]. 9p.

The design, construction, and operation of an air-bath comparator used for calibrating liquid-in-glass thermometers is described. The three main considerations in the design of this apparatus were: to produce a constant temperature, to provide direct viewing of the thermometers being tested, and to keep the construction relatively simple. A constant temperature was achieved by controlled heating of the cold air from the cooling coil. The control system consists of a platinum resistance control sensing element, a Wheatstone bridge, a d-c microvolt amplifier, a three-action current adjusting type controller, and a transistorized d-c power amplifier. (H.G.G.)

**18543** (TID-14035) UNITIZED SYSTEM OF IMAGE INTENSITIES USING FIBER OPTICS. Progress Report, October 1, 1960 to June 22, 1961. J. S. Kalafut (Westinghouse Electric Corp. Electronic Tube Div., Elmira, N. Y.). June 22, 1961. Contract AT(30-1)-2176. 45p.

Four light intensifier types were processed. One had a 5-in. diameter fiber-optic input window and a 1-in. diameter fiber-optic output window. The other three had 5-in. diameter fiber-optic input windows and borosilicate output windows. Two of the latter displayed stable photocathodes with luminous sensitivities >40 μa/lumen. Of these two both had a vast amount of cathode pattern; one also had high background characteristics. The fiber-optic faceplates displayed circular semi-opaque patterns in the body of the glass, but the luminous sensitivity of the pattern area varied only slightly relative to the clear areas. The single first-type intensifier exhibited a high (about 100 μa/lumen) initial luminous sensitivity that decreased at the rate of about 1 μa/lumen/hour because of a leak in fiber-optic window. The tube sensitivity to leaks proved to be far greater than that of present leak detectors. Experiments were performed on tubes of similar design to reduce and control the high background observed in these intensifiers. Partial success was achieved with selective heating, high voltage seasoning, and VACION pumping. Sudden application of full operating voltage to one tube was found to increase its susceptibility to field emission glow. Tests were also performed to develop substrates to prevent interaction of the lead glass with the alkali metals employed in photocathode processing. Tests examined effects of various things (MgF layers, etc.) on S-11 cathode processing at ambient and elevated temperature. MgF substrate showed a resistance to alkali penetration at elevated temperatures. Similar S-20 processing experiments were performed. Lime glass substrated faceplates arrived and proved acceptable. Leaks in the fiber-optic regions were sealed with silicone resin. Work on the ASTRACON with a photocathode made on a plain borosilicate input window centered on developing suitable photocathode processing techniques and designing the necessary electron optics. Fifteen photodiodes, eight with photocathodes, were processed and tested. Average luminous sensitivities were mediocre, partially due to nonuniform antimony evaporation. Multi-alkali (S-20) processing was dropped in favor of cesium antimony (S-9) processing. Eleven photodevices made after the change showed better uniformity and the

last one displayed good response. Development of an Astracon using fiber-optic windows on input and output ends with photocathodes made directly on the input window involved designing, building, and test-leaking fiber-optic input and output sections. The decision to make the orthicon entirely of soft glass to permit use of frit sealing techniques on the fiber-optic faceplate was made. Breakage difficulties in fabrication of the image stem were encountered. (D.C.W.)

**18544** (TID-16616) ELECTROMAGNETIC FLOWMETERS FOR VOID FRACTION MEASUREMENT IN TWO-PHASE METAL FLOW. J. B. Heineman, J. F. Marchaterre, and S. Mehta (Argonne National Lab., Ill.). June 1962. Contract [W-31-109-Eng-38]. 11p. (UAC-6571)

A theoretical method for measuring the vapor volume fraction in flowing two-phase metal systems is presented, and corroborated by experimental data from a two-phase, two-component flow loop. (auth)

**18545** (TID-16632) 500 TO 10,000 VOLT POSITIVE POWER SUPPLY WITH VARIABLE SWEEP RATES. Frank W. Reed (Argonne National Lab., Ill.). May 1962. Contract [W-31-109-eng-38]. 15p. (UAC-6476)

The power supply described is used primarily as an accelerating potential for mass spectrometers. An unusual design feature of this supply is the high impedance sensing of electrometers coupled with the low impedance and stability of cathode followers. This technique, of cathode following critical circuits, minimizes stray pickup and loading of sensitive circuits. The high output current and low impedance of the supply allows the use of lower impedance divider strings for the mass spectrometer focusing anodes allowing anode operation at lower impedances resulting in less beam modulation caused by noise and ripple. This improves the resolution of the mass peaks at about 50%. (auth)

**18546** (TID-16640) A SOLID STATE PULSE-HEIGHT ENCODING SYSTEM WITH PILE-UP REDUCTION FOR COUNTING AT HIGH INPUT RATES. Michael G. Strauss (Argonne National Lab., Ill.). June 1962. Contract W-31-109-Eng-38. 41p. (UAC-6547)

The system described selects undistorted pulses and digitizes them for multichannel pulse-height analysis. The system consists of a double RC differentiating linear amplifier, a low jitter gated single channel analyzer, a linear gate, and an analog to digital converter (ADC). The ADC is comprised of a simple discharge-type pulse-height-to-time converter, gating a temperature-compensated 2 Mc astable multivibrator. A temperature change of 25°C results in an overall gain change of 1%. Base-line shift is minimized by direct coupling. At an input rate of 100,000 pulses/sec the spectrum shifts by less than 1%. Pile-up events are rejected by a unique base-line crossing discriminator. The apparent pulse width, from pile-up considerations, is thereby reduced from 1.5 μs to 0.25 μs. The system has a differential nonlinearity of ±1%. The circuits and their performance are discussed. (auth)

**18547** (TID-18396) USE OF THE P-GRAM CONSTRUCTION FOR THE CALCULATION OF CHOPPER BURST SHAPES. J. M. Carpenter (Michigan. Univ., Ann Arbor). [nd]. Contract AT(11-1)-917. 18p.

The method of the P-gram construction is used to calculate the burst shape for one or more chopper rotors; i.e., the number of neutrons transmitted at any given time. The effects of any collimating devices in the chopped beam are included in a conceptually simple manner. The utility of the P-gram construction is further enhanced if there is more than one collimator in the beam, since the event of transmission through all consists of transmission through each individually. The P-gram picture consists of several overlapping P-grams, each appropriate to one collimating element, and the overlapping areas are those in which the joint transmission probability is unity. Only the shape of the P-gram for neutrons which cross the rotor centerplane at time zero, at which time the slit centerline is parallel to the x axis, is considered. The shape will depend upon the physical configuration of the rotor, the neutron speed, and the rotor angular speed. The equations for the apparent slit boundaries as seen by a neutron crossing the rotor centerplane at time zero are derived. A definition and derivation of an expression of the burst shape function is presented. (H.G.G.)

**18548** (TID-18397) A CONSTRUCTION FOR THE INVESTIGATION OF COLLIMATOR PERFORMANCE. J. M. Carpenter (Michigan. Univ., Ann Arbor). [1962]. Contract AT(11-1)-917. 37p.

A construction is described which gives a graphic representation of the angular and spatial distribution of neutrons in a beam defined by one or more Collimators of arbitrary complexity. A geometrical separation into two planes is used; the plane which determines instrument resolution and that which is irrelevant to the resolution for small angles. Angular and spatial distribution functions for neutron densities are derived. The construction is applied to the optics of a simple crystal spectrometer, and an approximation is exhibited in which the wave length-spatial distribution at a detector is displayed. Equations are given for several types of collimators. (auth)

**18549** (TID-18408) NEUTRON CROSS SECTION AND SPECTRA STUDIES. Technical Progress Report. P. F. Zweifel (Michigan. Univ., Ann Arbor. Coll. of Engineering). Feb. 1963. Contract AT(11-1)-917. 17p. (ORA-03712-5-P)

The development of a neutron monochromator and time-of-flight spectrometer is described, with particular attention to the collimator, shutters, and detectors. Experimental and theoretical analyses of the system's performance are outlined. (T.F.H.)

**18550** (TID-18409) DEVELOPMENT LEADING TO AN IMPROVED DENSITOMETER FOR HELIUM–GRAPHITE OR NITROGEN–GRAPHITE FLOW STREAMS. Quarterly Report No. 189-15, November 1962–January 1963. Donald H. Strobel (Badger Meter Mfg. Co., Milwaukee). Mar. 27, 1963. Contract AT(11-1)-1111. 16p.

A discussion of the development of an instrument for measuring the density of helium-graphite and nitrogen-graphite flow streams is presented. Mixture loading will be at a mixture density of 0.0028 to 0.043 gm/cc at 600°F and 250 psi. The density meter is a closed loop servo system using radioactive isotopes for the density sensing transducers. Calibration of the system is independent of isotope decay, detector gain changes, servo gain changes, ambient nuclear radiation, and radiation present in the flow stream. Operating conditions for the unit are at temperatures up to 600°F, pressures up to 250 psi, flow stream velocities of 50 to 250 ft/sec, and graphite particle size of 1-2 μ. (H.G.G.)

**18551** (TID-18427) A VERY-THIN-WALLED SAMPLE HOLDER FOR LIQUIDS. C. D. Striffler and J. M. Carpenter (Michigan. Univ., Ann Arbor. Coll. of Engineering). Feb. 1963. Contract AT(11-1)-917. 5p. (ORA-03712-3-T)

The development of a sample holder to be used in the preparation of a sample for investigating neutron scattering from light water is described. Aluminum was chosen as

the material for the sample holder because of its low cross section and its availability in a variety of thicknesses. The principle by which the walls of the sample holder are held flat and sealed depends upon squeezing an O-ring into a groove with beveled sides in such a manner that the O-ring expands diametrally while being squeezed. The aluminum foils are held tightly by the O-ring and are uniformly stretched two-dimensionally, while simultaneously the O-ring makes a seal against the foils. The desired sample thickness is established by a spacer between the foils. (H.G.G.)

**18552** (TRG-Report-468) A BASIC TRAINING SCHEME. PART I. CALIBRATION AND ADJUSTMENT OF PNEUMATIC INDICATORS: PROJECTS. R. A. Chapman (United Kingdom Atomic Energy Authority. Reactor Group, Dounreay, Caithness, Scotland). Jan. 16, 1963. 32p.

A program for the purpose of training selected craft apprentices who will become acceptable in the UKAEA or in industry in general as instrument mechanics is discussed. It is important that an instrument craftsman should be skilled in all common types of instrumentation and not just be competent in electronics, as, in many cases, the physical method is used for its marked simplicity and reliability. Pneumatic indicators are given first treatment showing, by graded exercises, a pattern of calibration and also demonstrating how various units of pressure are interrelated. The projects cover a range of instruments from Bourdon pressure gages to quite sensitive capsule gages, using the dead-weight tester, standard gages or water manometers as test instruments. The apprentices are taught to recognize symptoms of fault and correct remedial action. The structure of the course in discrete projects enables the handling of such problems as day release and various other short absences. (auth)

**18553** (TRG-Report-486) A BASIC TRAINING SCHEME. PART II. CALIBRATION AND ADJUSTMENT OF ELECTRICAL INDICATORS: PROJECTS. R. A. Chapman (United Kingdom Atomic Energy Authority. Reactor Group, Dounreay, Caithness, Scotland). Feb. 4, 1963. 32p.

The projects given form the second part of a course the purpose of which is to train selected craft apprentices who will become acceptable as instrument mechanics. This section of the course covers the use and range adjustment of the multirange meter. The pattern of calibration is repeated electrically to impress the analogous features of pneumatic and electrical systems. The operation of a precision bridge and potentiometer is demonstrated. An introduction to Standards Room methods is presented and the importance of tolerance margins is stressed. (auth)

**18554** (TRG-Report-487) A BASIC TRAINING SCHEME. PART II. CALIBRATION AND ADJUSTMENT OF ELECTRICAL INDICATORS: NOTES. R. A. Chapman (United Kingdom Atomic Energy Authority. Reactor Group, Dounreay, Caithness, Scotland). Feb. 18, 1963. 47p.

A course was prepared to provide basic training in the primary features of instrumentation. The purpose of this course is to prepare apprentices, at an early stage in their training, to receive on site the traditional instruction given by craftsmen. The staff required to run this course consists of a lecturer for theory supported by a craftsman chosen for his practical knowledge of the work. The course is grouped into projects and each project is based on an operation which may be encountered daily by an instrument craftsman. Notes for the guidance of the instructor are given covering safety, craft, and theory aspects together with model answers to the problems posed in the second group of projects (Projects 11 to 22 inclusive). (auth)

**18555** (UCRL-10009(Rev.)) AN INTEGRAL DESIGN TECHNIQUE FOR WIDEBAND MULTISTAGE TRANSISTOR AMPLIFIERS. Larry Scott (California. Univ., Berkeley. Lawrence Radiation Lab.). Apr. 27, 1962. Contract W-7405-eng-48. 32p.

A philosophy for designing wideband multistage transistor amplifiers is discussed. The amplifier is visualized as an integral unit, the interstage networks constituting the elements of the amplifier unit. By designing the amplifier as a unit and adjusting the over-all response (gain and bandwidth) with the interstage time constants, an increase in gain-bandwidth product is realized over the iteratively designed amplifiers. The resulting increase in gain-bandwidth product results from absence of the bandwidth shrinkage factor for multistage amplifiers. Formulas are derived for both a two- and three-transistor integrally designed wideband amplifier, in which shunt peaking networks are used for coupling. Experimental amplifiers were constructed following these formulas, and the observed performance agreed with the calculations. (auth)

**18556** (UCRL-10196) A WIDEBAND GAIN CONTROL. Larry Scott (California. Univ., Berkeley. Lawrence Radiation Lab.). Apr. 26, 1962. Contract W-7405-eng-48. 9p.

A design is presented for a wide-bandwidth gain-control stage used in a pulse amplifier, Model 10-03 ns, that has a maximum voltage gain of 10 and a rise time (10 to 90%) of 3 nsec. Circuitry is not complicated by compensation difficulties, which were circumvented by placing the potentiometer at a very low impedance node, and by using low values of potentiometer resistance. (auth)

**18557** (Y-1414) A VERSATILE SPECTROMETER MAGNET POWER SUPPLY. W. A. Groppe (Union Carbide Nuclear Co. Y-12 Plant, Oak Ridge, Tenn.). Jan. 25, 1963. Contract W-7405-eng-26. 25p.

A more versatile magnet supply was needed for mass spectrometer work. Commercial equipment which fits all the desired applications was not available. An instrument, incorporating controls to allow simpler and better readout of peaks than was before possible, was designed, fabricated, tested, and installed. Early results from actual laboratory operation show satisfactory performance from both the operating and maintenance standpoints. (auth)

**18558** (Y-1415) A PLUG-IN-TYPE MASS SPECTROMETER SURFACE IONIZATION SOURCE FOR USE WITH A VACUUM LOCK. W. W. Rice (Union Carbide Nuclear Co. Y-12 Plant, Oak Ridge, Tenn.). Jan. 29, 1963. Contract W-7405-eng-26. 15p.

A plug-in-type surface ionization source has been designed and built to be used with a mass spectrometer equipped with a vacuum lock. The sample filament mounts on a male plug which fits into a female receptacle mounted on a case plate. A firm electrical contact is realized. Sample plugs are changed without loss of vacuum and can be used with any geometrically orientated analyzer tube. (auth)

**18559** (UCRL-Trans-899(L)) MECHANICAL SELECTOR FOR SLOW NEUTRONS. G. Gobert and B. Jacrot. Translated by Sergey Shewchuck (Univ. of California Lawrence Radiation Lab., Livermore) from J. Phys. Radium, 19: 51A-60A(1958). 22p.

A mechanical selector of slow neutrons constructed of two rotors (diameter 1m) 1 m apart is described. The rotation speed is 6000 rpm. The width of the line obtained is—under the best conditions—about 0.2 Å, and the pulse duration is about 50 μsec. The mechanical problems encountered during the construction are analyzed. (auth)

**18560** A VERSATILE ELECTRONIC TIMER-SCALER. Y. Chiba and T. Dazai. Bull. Tokyo Inst. Technol., Spec. No. 49, 19-25(1962). (In English)

A versatile electronic timing circuit is described. It provides varieties of crystal-controlled time gates to drive external circuits and makes possible an automatic data accumulation when combined with some recording systems. (auth)

**18561** GETTING SUBNANOSECOND PRECISION IN COAX CABLE DELAY MEASUREMENTS. E. F. Laine (Univ. of California, Livermore). Electronics, 36: 3p. (Feb. 1, 1963). (UCRL-7078)

A method for determining delay times of coaxial cables by sending a pulse down the line and having the reflected pulse retrigger the pulse generator to produce sustained oscillations is described. The resulting pulse repetition rate is proportional to cable delay and can be measured with a digital pulse counter. (M.C.G.)

**18562** PULSE AMPLIFIERS FOR NUCLEAR MEASUREMENTS. [PART] II. Agustín Tanarro Sanz and José E. De Carlos Romero (Junta de Energia Nuclear, Madrid). Energia Nucl. (Madrid), 6: 4-32(July-Sept. 1962). (In Spanish)

The study of pulse amplifiers for nuclear measurements is concluded with a discussion of the background noise and pulse shaping. Four typical amplifiers are described in some detail. (J.S.R.)

**18563** MULTIPLE DISPERSION MASS SPECTROMETER WITH ION MIRROR. Tamotsu Noda (Hitachi Ltd., Ibaragi, Prefecture, Japan), Itiro Omura, and Nozomu Morito. Japan. J. Appl. Phys., 2: 128-9(Feb. 1963).

Ion mirrors are introduced to realize multiple dispersion in a single magnetic field of a mass spectrometer. An ion source, two ion mirrors, and an ion collector are suitably placed around a magnetic field. The ion mirrors can also be used as ion collectors. If the polarity of the accelerating voltage is reversed, negative ions can be analyzed. (C.E.S.)

**18564** ENHANCEMENT OF REVERSE CURRENT IN SEMICONDUCTOR DIODES BY ELECTRON BOMBARDMENT. Eiichi Miyazaki and Kohichi Miyaji (Matsushita Elec. Ind. Co., Ltd., Ikuta, Kawasaki, Japan). Japan. J. Appl. Phys., 2: 129-30(Feb. 1963).

The current change in reverse-biased Si(n-type)-Au (thin film) contacts caused by bombardment with an electron beam of 10 kv was measured. The Au film was ~0.02 $\mu$ in thickness, so the electron beam could penetrate it to produce secondary electron-hole pairs both in the barrier layer and in the bulk Si. The results show a possibility of constructing a new device of high speed and high gain by electron beam and solid diode combination. (C.E.S.)

**18565** PRACTICAL EXPERIENCE WITH THE NUCLEAR TRACK MEASURING MICROSCOPE KSM 1. Claus Grote and Ullrich Krecker (Nuclear Physics Inst., German Academy of Sciences, Berlin). Jena Rev., 4: 141-4(Aug. 1962). (In English)

Some special problems and general experience with the KSM 1 microscope for studies of nuclear emulsion tracks are discussed. The most widely used method for the determination of momentum of high-energy particles in nuclear track emulsion is the measurement of the Coulomb multiple scatter. Errors in measurement are caused by stage noise, grain reading noise, and spurious scatter. Minimal stage noise is an outstanding feature of the KSM 1. The setting accuracy of this microscope is 0.05 to 0.10 $\mu$. (M.C.G.)

**18566** 5 Mc/s POSITIVE ION KLYSTRON. M. R. Gavin and K. Chandra (University Coll. of North Wales, Bangor). J. Electron. Control (1), 14: 65-79(Jan. 1963). (In English)

A two-resonator klystron amplifier was developed using argon ions and operating at a frequency of 5.4 Mc/s. The performance agrees well with the accepted theories of velocity modulation. The results suggest that low-frequency ion devices could be used as analogs of microwave electron devices. (auth)

**18567** CALCULATION OF DISPERSION OF IRIS-LOADED CYLINDRICAL ELECTROMAGNETIC WAVEGUIDES. R. Taylor (Rutherford High Energy Lab., Harwell, Berks, Eng.). J. Nucl. Energy, Pt. C, 4: 418-20 (Dec. 1962).

It is found in a typical case that the frequency that corresponds to a given phase change per period of an electromagnetic wave can rapidly be found to better than one per cent throughout the range $(0,\pi)$ and that without excessive computation this can be improved to 0.2 per cent. (C.E.S.)

**18568** FAR-INFRARED INTERFEROMETER FOR THE MEASUREMENT OF HIGH ELECTRON DENSITIES. Sanborn C. Brown, G. Bekefi, and R. E. Whitney (Massachusetts Inst. of Tech., Cambridge). J. Opt. Soc. Am., 53: 448-53 (Apr. 1963).

An infrared interferometer that operates at 0.03 cm wavelength and is able to detect electron densities above $5 \times 10^{13}$ cm$^{-3}$ in a plasma column 1 cm thick is described. In the design, incoherent radiation from a mercury arc lamp is split by a diffraction grating and the plasma placed in one of the diffracted beams. The beams are then recombined and fringe shifts measured by a Golay detector. (auth)

**18569** DESCRIPTION OF A CRYOSTAT THAT CONTROLS TEMPERATURE. G. Monod-Herzen, A. t'Kint de Roodenbeke, and H. Giquelais (Faculté des Sciences, Rennes, France). J. Phys. Radium, 23: Suppl. No. 12, 147A-50A(Dec. 1962). (In French)

Research in thermoluminescence requires not only low temperatures, but the control of their variations with time, mostly linear. A cryostat was designed to fulfill these requirements; its first performance is satisfactory. (auth)

**18570** A TIME-RESOLVED NORMAL-INCIDENCE VACUUM ULTRA-VIOLET SPECTROGRAPH. A. H. Gabriel and W. A. Waller (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). J. Sci. Instr., 40: 10-13(Jan. 1963).

The instrument described will record photographically a time-scanned spectrum of a pulsed event in the vacuum ultraviolet region. It covers any 1000 Å range between 500 and 2500 Å with a dispersion of $8 \cdot 3$ Å mm$^{-1}$. Time resolution is achieved by reflection from a rotating mirror and has a maximum value of $3 \cdot 1$ mm $\mu$sec$^{-1}$. Some experimental results are shown. (auth)

**18571** GEOMETRICAL FACTORS INFLUENCING THE DESIGN OF AUTOMATIC SINGLE-CRYSTAL X-RAY AND NEUTRON DIFFRACTOMETERS. W. A. Wooster (Crystal Structures Research Ltd., Cambridge, Eng.). J. Sci. Instr., 40: 14-19(Jan. 1963).

X-ray and neutron diffractometers are classified into five groups. The first group is based on an analogue mechanism for setting the crystal, and the other groups all employ gear wheels which must be individually set for each reflection. A survey is made of these instruments taking into account the following features: (i) the percentage of possible reflections which the geometry of the

apparatus allows to be recorded; (ii) the complexity of the Lorentz and other corrections; (iii) the time for resetting the crystal between successive observations; (iv) the accuracy of settings; (v) the usefulness in connection with reflections depending on anomalous dispersion; (vi) azimuthal angles; (vii) difficulty of mechanical construction. (auth)

**18572** A SIMPLE X-RAY MICROBEAM CAMERA. W. Taylor and A. Moore (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). J. Sci. Instr., 40: 46-7(Jan. 1963).

A microbeam camera was built for determining orientations of small areas of metallurgical specimens by the Laue back reflection technique. This camera was used with a beam collimated to 100 μm in a study of deformation in beryllium. (D.L.C.)

**18573** PARASITIC RADIATIONS IN X-RAY TUBES. R. J. Davis (Dept. of Mineralogy, British Museum (Natural History), London). J. Sci. Instr., 40: 79-81(Feb. 1963).

A number of sealed-off x-ray tubes were found to become contaminated with iron, giving parasitic radiation. Simple tests for this are described. The effect is worse in more modern tubes. A case is described where the background white radiation gives rise to reasonably sharp lines on a powder photograph. (auth)

**18574** RADIATION VS. ELECTRONIC COMPONENTS. Edward J. Rohrbach and Howard S. Goldstein (Airborne Instruments Lab., Cutler-Hammer Inc., Deer Park, N. Y.). Machine Design, 35: No. 1, 101-4(Jan. 3, 1963).

The effects of radiation on electronic components are discussed. Those covered include: semiconductors, resistors, capacitors, relays, switches, and magnets. A table of radiation tolerance limits is included. (M.C.G.)

**18575** CONTINUOUS MEASUREMENTS ON A MODULATING SYSTEM. R. Gariod and E. Tournier (Centre d'Études Nucléaires, Grenoble, France). Onde Elec., No. 427, 7p.(Oct. 1962). (CEA-2247) (In French)

A number of measuring and testing instruments were developed for which interesting characteristics were obtained through modulation. Use of the synchronous demodulation after a previous modulation was used in the device is described. The fundamentals of some embodiments applied to nuclear and physical parameter measurements are given. (auth)

**18576** AUTOMATIC NEUTRON DIFFRACTOMETER FOR THREE-DIMENSIONAL STRUCTURE-FACTOR DETERMINATION. U. W. Arndt (Royal Institution, London) and B. T. M. Willis. Rev. Sci. Instr., 34: 224-30(Mar. 1963).

This fully automatic single-crystal diffractometer employs the Eulerian hoop geometry. It is under punched-tape control and the three independent shafts are set simultaneously for each reflection to an accuracy of 0.03° using a moiré fringe positioning system. The reflection is then measured by moving the crystal in steps across the reflecting position. The time on each step is variable, being determined by a monitoring counter, and the number of steps is under program control. Results are both printed in plain language and punched on a paper tape, ready for direct processing in a computer. (auth)

**18577** AUTOMATIC PLOTTING DEVICE FOR THE SECOND DERIVATIVE FOR LANGMUIR PROBE CURVES. G. R. Branner, E. M. Friar, and G. Medicus (Advanced Techniques Branch, Wright-Patterson AFB, Ohio). Rev. Sci. Instr., 34: 231-7(Mar. 1963).

An electronic device for automatically plotting the second derivative of probe curves is described in detail. A small sinusoidal signal is superimposed on the d-c probe voltage which is swept manually. The second harmonic in the probe current is filtered, amplified by a low noise cascade amplifier, rectified by a phase-true rectifier, and plotted by an X-Y recorder. The components, the critical points in their wiring, and the performance of the system are described. A quantitative comparison is made with related devices. The system described here is somewhat simpler than the competing ones and has the advantage of being applicable to the first and the third derivatives as well. (auth)

**18578** FREQUENCY-SWEPT AND PROTON-STABILIZED NMR SPECTROMETER FOR ALL NUCLEI USING A FREQUENCY SYNTHESIZER. Edward B. Baker and L. W. Burd (Dow Chemical Co., Midland, Mich.). Rev. Sci. Instr., 34: 238-43(Mar. 1963).

The high-resolution proton-stabilized, and frequency-swept spectrometer of Baker and Burd was limited to proton spectra. A modification of this instrument suitable for all magnetic nuclei is described, based upon the use of a Rhode and Schwarz frequency synthesizer. This modification provides generation and detection of an unmodulated signal at the frequency of another nuclear species, while retaining the features of proton stabilization and precalibration on a frequency scale of the older instrument. Frequency scans from 10 cps to 2 kc may be shifted in precise increments by means of crystal oscillators and the lock-on features of the synthesizer. In going from one nuclear species to another, ratios of magnetogyric ratios are given automatically to high precision. Examples of spectra are given. (auth)

**18579** TWO SYNTHESIZER NUCLEAR SPIN DECOUPLING; INDOR SPECTROSCOPY. Edward B. Baker, L. W. Burd, and G. N. Root (Dow Chemical Co., Midland, Mich.). Rev. Sci. Instr., 34: 243-6(Mar. 1963).

A proton-stabilized, frequency-swept, high resolution NMR spectrometer using a frequency synthesizer was described previously by E. B. Baker and L. W. Burd. The addition of a second synthesizer and suitable power amplification allows a variety of nuclear spin decoupling experiments to be carried out with any pair of nuclear species, including internuclear double resonance (INDOR) experiments. For INDOR experiments a dispersion signal lock-on provides extra stability for resting on the peak of a very sharp absorption line. A $P^{31}$ INDOR spectrum of trimethyl phosphite is shown as an example. (auth)

**18580** ULTRA-HIGH VACUUM USE OF BAYARD-ALPERT IONIZATION GAUGES. Thomas E. Hartman (Texas Instruments, Inc., Dallas). Rev. Sci. Instr., 34: 281-5(Mar. 1963).

Comparisons are made between the collected ion current vs electron emission current for a "nude" gage (Veeco BGT-75) and a glass enclosed gage (Veeco RG-75) both of the Bayard-Alpert type. The ion current is directly proportional to the electron current for the nude gage, when the electron current is 100 μa or less, down to ion currents as low as the x-ray limit of the gage which is $3 \times 10^{-10}$ Torr. Good agreement between the glass and nude gages is obtained over the limited range of electron currents where the glass gage exhibits proportional behavior. A getter-ion pumped ultra-high vacuum system was used for the experiments. (auth)

**18581** MAGNETORESISTANCE PROBE FOR MEASURING MAGNETIC FIELD INTENSITY IN A SMALL SPACE. F. S. L. Hsu and J. E. Kunzler (Bell Telephone Labs., Inc., Murray Hill, N. J.). Rev. Sci. Instr., 34: 297-8(Mar. 1963).

The construction and use of magnetoresistance probes of

commercial copper wire for fields from a few kG to ~100 kG at liquid-helium temperatures are described. Results of the calibration of one probe section are given. The sensitivity of the probes in the high-field region is 10 $\mu$v/kG; it is less in lower fields, although it can be improved by using pure copper or bismuth. (D.L.C.)

**18582** SIMPLE AID TO PULSE-HEIGHT SELECTION WITH SCANNING X-RAY SPECTROMETERS. F. Behn Riggs, Jr. (Smithsonian Astrophysical Observatory, Cambridge, Mass.). Rev. Sci. Instr., 34: 312(Mar. 1963).

In the use of x-ray diffraction spectrometers with proportional counters and pulse-height selection, the equation SV = CG should be true, where S = dial reading of the spectrometer, V = amplified pulse amplitude, C = constant, and G = gain. A device is described for satisfying the equation by varying the base height V of a pulse-height selector while an automatic mechanism drives S linearly in time. The device consists of a drum and thread for turning the potentiometer that controls the base voltage. (D.L.C.)

**18583** INTERFERENCES OF THE PRESSURE MEASUREMENT IN THE VICINITY OF A GAS DISCHARGE. Erich W. Blauth and Bernhard M. U. Scherzer (Institut für Plasmaphysik, Munich). Z. Angew. Phys., 15: 28-31 (Jan. 1963). (In German)

The fact that metal radicals dimerize under the effect of the energy released by the dissociation energy has been long known. In pressure measurement technology the significance of this phenomenon was frequently overlooked. The possible errors in pressure measurements resulting from the dimerization are studied. It was shown that the pressure measurement in the vicinity of a gas discharge is completely feasible with heat-conducting manometers when the introduction of radicals into the manometer is prevented. A dimerization trap is described which is adequate for this purpose. The results are valid for pure uhv conditions in glass apparatus. In oil-coated apparatus, the gas discharge can effect both a pressure rise and a pressure drop. (tr-auth)

**18584** MATERIAL FLOW DETECTOR AND METHOD. Roderick A. Dennis (to Research and Aviation Development, Inc.). U. S. Patent 3,084,250. Apr. 2, 1963. Filed Nov. 24, 1959.

An apparatus is designed for detecting material flow and its rate of flow by neutron activation and monitoring. The apparatus comprises a neutron emitter, a shield controlling the emission from the emitter, a first and second detector means on one side of the shield for detecting the induced activity in the material, and timing means for measuring the rate of flow. A spectrometer may also be used to determine the detected radioactive elements in the material. The use of the apparatus to detect oil leakage in an oil well is described. (D.L.C.)

**18585** NEUTRON GENERATOR. Charles W. Tittle and Alexander Thomas (to Lab. for Electronics, Inc.). U. S. Patent 3,084,256. Apr. 2, 1963. Filed Sept. 3, 1957.

A neutron generator is designed for producing a high flux of neutrons in confined spaces, such as in well logging. In this generator, thermionic electrons are accelerated to bombard a target electrode in a low-pressure atmosphere of hydrogen isotope to produce D or T ions, which in turn are accelerated into neutron-producing collisions with a second target electrode. The dynamic pressure is maintained in the micron range to prevent the formation of diatomic ions. (D.L.C.)

**18586** ELECTRICAL CIRCUITS PERFORMING A SWITCHING FUNCTION. John Keith Beadsmoore (to United Kingdom Atomic Energy Authority). U. S. Patent 3,084,287. Apr. 2, 1963. Priority date Nov. 13, 1958, Great Britain.

A circuit is designed for switching at high speeds which has one possible application in temperature measurements from a large number of thermocouple points in a reactor. The circuit comprises a counting valve, load resistances connected between the electrodes of the valve and a first output terminal common to all load resistances, an adjustable tapping point on each load resistance, and unidirectional conducting devices for conduction from the tapping points to respective terminals of two-terminal points, the other terminals being connected together to a second output terminal. A circuit for covering more than the maximum number of cathodes in a single valve is also described. (D.L.C.)

## Radiation Detection

*Refer also to abstracts 17643, 18377, 18479, 18480, 18481, 18486, 18487, 18488, 18490, 18491, and 19010.*

**18587** (AD-283836) RESEARCH INVESTIGATION OF P-I-N ELECTRON JUNCTION DETECTORS. Summary Engineering Report, July 1, 1961 through July 31, 1962. (Hughes Aircraft Co. Hughes Research Labs., Malibu, Calif.). Aug. 1962. Contract NObsr 85511. 58p.

The use of p–i–n junction Si radiation detectors was examined from the point of view of their dosimetric properties. Three different modes of detector operation were examined so as to encompass a very broad range of dose rates. By choosing the proper mode of operation, dose rates of the order of 0.1 mr/hr to a few hundred r/min can be encompassed. The wavelength dependence for x radiation ranging in quality from 0.8 mm Al to 14 mm Cu HVL was examined for such detectors when used as current generators. Preliminary studies of secondary-emitting radiators on the wavelength characteristic were made. Response of the detector, when operated both as a current generator and a voltage source, was compared with extrapolation chamber measurements for isotopic sources emitting beta and gamma rays. The work indicates that elimination of the thick dead layer should provide improved performance and improved wavelength response characteristic. The preliminary data using secondary-radiation-generating materials indicate that, at least in the case of high-energy radiations, satisfactory Bragg-Gray chambers should be possible using small, spherical detectors. (auth)

**18588** (AERE-R-4214) NEUTRON TIME-OF-FLIGHT SPECTROMETER DRIVE UNITS. R. F. Dyer (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Jan. 1963. 13p.

The operating experience that was obtained with drive units produced by the Rover Co. Ltd. to Harwell specification is described, and details of the performance characteristics of the hydrostatic bearings used in these units are given. A detailed description is included of modifications to the units to accommodate a new design of bearing and mounting, followed by performance figures for the new bearings showing their superiority over the original design. (auth)

**18589** (ATL-A-124) DESIGN AND DEVELOPMENT OF FAST-RESPONSE THERMOPILE-TYPE NEUTRON-FLUX-SENSITIVE DEVICE. Final Report, Phase 2. L. J. Gee (Advanced Technology Labs. Div. of American-

Standard, Mountain View, Calif.). Oct. 31, 1962. Contract AT(04-3)-250. 39p.

A program was directed toward development of a thermopile-type neutron-flux-sensitive meter of small physical size and having a fast response time (25 msec) and a high signal output. The meter configuration selected consists essentially of a metallic heat sink, a thermopile, and a thin layer of neutron-sensitive material in series. When the meter is exposed to a neutron environment, heat generated in the neutron-sensitive material flows across the thermopile unit to the heat sink. The signal output generated by the thermopile is proportional to the heat flow, which is in turn proportional to the neutron flux. Signal-output characteristics of meters of this configuration have been verified by experimental testing in the Battelle Research Reactor, the General Electric NTR Reactor, and the Materials Testing Reactor (Idaho Falls). A practical neutron meter, in which the sensing element measures approximately $\frac{1}{8}$ in. × $\frac{1}{2}$ in. × 1 in., with a time constant of less than 25 msec and a millivolt-level signal output at a thermal-neutron flux of $10^{12}$ n/cm$^2$-sec was achieved, thus substantially fulfilling the program objectives. (J.R.D.)

**18590** (BNL-6885) MIST — BUBBLE CHAMBER DATA REDUCTION PROGRAM. Jerry M. Friedman (Brookhaven National Lab., Upton, N. Y.). Feb. 1963. Contract [AT(30-2)-Gen-16]. 28p.

MIST is an IBM 7090 program prepared at Brookhaven National Laboratory as part of a cooperative effort for bubble chamber data processing. The program reads the prepared data and outputs it on magnetic tape in a suitable format for input to the Haze-Fog-Cloudy-Fair Programs used with a flying spot digitizer. MIST deletes erroneous data, edits, sequences, and supplies additional physical data not digitized. MIST also prepares detailed summaries and statistics for the events processed and checks digitizer operation. (H.G.G.)

**18591** (BNL-6889) INDEX OF REFRACTION AND DISPERSION OF SEVERAL GASES IN ČERENKOV COUNTER USE. J. A. Niederer (Brookhaven National Lab., Upton, N. Y.). Dec. 7, 1961. Contract [AT-30-2-GEN-16]. 13p.

Measurements of index of refraction as a function of gas pressure for carbon dioxide, ethane, methane, sulfur hexafluoride, Freon 13, Freon 14, and Freon 23, which are suitable for Čerenkov Counter use, are reported. These gases do not react with Al or Ag mirror coatings, or other materials used in such counters, and have indices of refraction that are large enough to permit the use of these gases at reasonable pressures. Methane and ethane are both toxic and highly explosive; the remainder of the group listed are non-toxic and very stable. Carbon dioxide appears to be the most suitable gas of this group for a precise determination of high energy particle velocity in a Čerenkov Counter from pressure-refractive index calibration data. Data indicate that methane and ethane have the highest dispersion of the gases of this group and Freon 23 has the lowest. Dispersion is a more serious limitation to ultimate Čerenkov counter resolution at very high energies than is multiple scattering. In some Čerenkov Counter uses, a minimum of particle attenuation may be desirable; methane offers the smallest nuclear cross section of these gases. Carbon dioxide does not present major difficulties in attenuation or multiple scattering, and its dispersion appears to permit acceptable Čerenkov angular resolution within the range of particle energies encountered in AGS operation. (H.G.G.)

**18592** (BNL-6899) A CALIBRATION CURVE FOR COSMOTRON IONIZATION CHAMBERS. G. Levine and C. Swartz (Brookhaven National Lab., Upton, N. Y.). Nov. 7, 1960. Contract [AT(30-2)-Gen-16]. 4p.

A curve relating the output signal from the thin-walled ionization chambers of the cosmotron to the number of protons passing through the chambers for fast r-f turnoff is presented. (D.C.W.)

**18593** (CERN-63-4) LOW LEVEL PROPORTIONAL COUNTER FOR TRITIUM. St. Charalambus and K. Goebel (European Organization for Nuclear Research, Geneva). Feb. 10, 1963. 29p.

A proportional counter for the measurement of low Tritium activities is described. The cylindrical proportional counter with a volume of about 600 cm$^3$ is the inner part of a low level counting system in which the guard counter (anti-coincidence counter) surrounds the principal counter (proportional counter) which is only separated from the annular counter by a thin foil. The ratio of the "transmit" to the "out" counting rate is high compared to other low level counting systems (of the order of 300). The specific feature of the design is the separation of the volume of the internal counter and the anti-coincidence counting ring. The special properties of the counter and some of its operations are discussed. (auth)

**18594** (CERN-63-6) THE TURN-TABLE FOR THE 2 m LIQUID HYDROGEN BUBBLE CHAMBER. A. H. Achermann (European Organization for Nuclear Research, Geneva). Mar. 4, 1963. 14p.

The design, manufacture, and acceptance testing of the turn-table for the 2-m liquid hydrogen bubble chamber for CERN is described in detail. The static load capacity of the turntable is calculated to be 5.3 kg/mm$^2$. This load is uniformly distributed on 108 supporting steel balls by 30 rubber cushions. (H.G.G.)

**18595** (CRGP-956) DESIGN OF A THIRD AXIS FOR THE CHALK RIVER CRYSTAL NEUTRON SPECTROMETER. W. McAlpin (Atomic Energy of Canada Ltd., Chalk River, Ont.). Feb. 1963. 71p. (AECL-1695)

The design and development of the third axis for the Chalk River Crystal Neutron Spectrometer are described. The appendices contain pertinent information on installation and detailed procedures for various aspects of operation. (auth)

**18596** (DP-471) AUTOMATIC DOSE COMPUTER FOR RADIATION FILM BADGES. John E. Davis (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). Apr. 1960. Contract AT(07-2)-1. 12p.

A combination densitomer and analog computer is described which determines radiation exposure of photographic film used in personnel badges. The range of the instrument is 0 to 300 mr $\gamma$ and 0 to 300 mrad $\beta$ plus $\gamma$. A novel phototube circuit is used to obtain logarithms directly. (auth)

**18597** (HW-54676) A SEMIPORTABLE HIGH SENSITIVITY SCINTILLATION COUNTER. R. C. McCall (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Jan. 24, 1958. Contract AT)45-1)-1350. 16p.

Development of highly sensitive scintillation counters for use in studies of the diffusion and mixing of the Hanford reactor effluents in the Columbia River is described. A large plastic scintillation detector was developed which can be carried in boats, cars, or planes, and which is capable of detecting radiation levels at or near normal background. (J.R.D.)

**18598** (KFK-127) TEILCHEN-SPEKTROMETER. (TEIL II). (Particle Spectrometer, Part II). S. Galster and G. Hartwig (Kernforschungszentrum. Institut fur Experimentelle Kernphysik, Karlsruhe, Germany). Dec. 1962. 35p.

The design proposal for a single-lens magnetic spectrometer for 700 Mev/c electrons is described. Topics covered include: straight quadrupole, bent magnets, bent air-coiled magnets, scintillation counters and Schwellen-Cherenkov counters. (M.C.G.)

**18599** (NP-12587) NUCLEAR RADIATION DETECTORS. Review Report No. 5. Adam Kazimierski (Polish Atomic Energy Commission. Information Center, Warsaw). 1962. 119p.

The book discusses several types of detectors, including ionization detectors, scintillation counters, Cherenkov counters, semiconductor devices, and crystalline detectors. Other types of detectors which are not discussed because of limited application include Wilson and bubble chambers, photographic emulsions, and chemical dosimeters. The principles of operation and proper use of the detectors are presented. The latest trends in the development of detectors are covered through the year 1961. The state of the production of detectors is treated and includes such factors as ability to mass produce, cost of production, and availability of basic materials. A list of 536 references is grouped according to detector type. (TTT)

**18600** (ORNL-3407) EXPERIMENTAL DETERMINATION OF CORRECTIONS TO THE NEUTRON ACTIVATION OF GOLD FOILS EXPOSED IN WATER. W. Zobel (Oak Ridge National Lab., Tenn.). Apr. 4, 1963. Contract W-7405-eng-26. 64p.

The corrections required to deduce unperturbed neutron fluxes from measurements with foil absorbers were determined experimentally for the case of gold foils exposed in a light-water medium. The results are in good agreement with the theoretical predictions of Dalton and Osborn and of Ritchie and Eldridge. (auth)

**18601** (RT/FI(62)56) A NEW DETERMINATION OF THE MEAN FREE PATH OF 25 Gev PROTONS IN PHOTOGRAPHIC EMULSIONS. P. G. Bizzeti, A. M. Cartacci, M. G. Dagliana, M. Della Corte, L. Tocci, G. Boebel, G. Tomasini, and A. Marzari-Chiesa (Italy. Istituto Nazionale di Fisica Nucleare, Rome). Dec. 1962. 7p.

The results and experimental details of a measurement of the mean free path in nuclear emulsions for very high energy protons are reported. The scanning procedure is described, and the corrections to be introduced owing to the beam contamination are discussed in detail. The value at 25-Bev proton energy comes out to be 32.6 ± 1.5 cm, significantly lower than values available up to now at the same energy. (auth)

**18602** (TID-16601) APPLICATION OF EXCIMERS TO LARGE LIQUID SCINTILLATION COUNTERS. I. B. Berlman (Argonne National Lab., Ill.). May 1962. Contract [W-31-109-eng-38]. 4p. (UAC-6480)

In liquid scintillation counters use is made of a solvent that transfers its excitation energy efficiently and of a solute with a high fluorescence quantum yield. Studies were made of transient excited dimers, called excimers by Stevens. The mechanism by which these excimers are formed can be visualized as an excited solute molecule, combining with an unexcited solute molecule, to form an excited dimer. Increasing the concentration of the solute increases the probability of forming excimers. These solutes possess the characteristic that although the wavelength of fluorescence radiation from the transient dimer is several hundred Å greater than the wavelengths of the radiation emitted from the excited monomers, the absorption spectrum remains that of the monomer. The abnormal wavelength interval between the absorption spectra and the emission spectra permits the fluorescence radiation from the excimers to travel long distances without reabsorption. (M.C.G.)

**18603** (TID-16602) $\alpha$ AND $\beta$ PULSE SHAPES IN ORGANIC SCINTILLATORS. Isadore B. Berlman (Argonne National Lab., Ill.). June 1962. Contract [W-31-109-eng-38]. 4p. (UAC-6536)

Mechanisms to account for the long tails on the scintillation pulses of fluorescence radiation in certain organic phosphors are discussed. (D.C.W.)

**18604** (TID-18300) REDUCTION OF PILE-UP CONTAMINATION IN PULSE-HEIGHT SPECTRA. Ralph E. Segel (Argonne National Lab., Ill.). Jan. 1963. Contract [W-31-109-eng-38]. 7p. (UAC-7184)

The method used is a standard system consisting of a double-delay-line-clipped amplifier feeding a pulse-height analyzer. An additional step used in suppressing pileup is to examine the pulses being fed into the PHA and to analyze only those that are free from pileup. This is done by using a feature of the pulse shape to distinguish a single from a composite (pileup) pulse. Data and block diagrams of the apparatus are included. (J.R.D.)

**18605** (TID-18405) THE EFFECT OF SAMPLE ORIENTATION ON COUNTING RATES IN A NEUTRON SPECTROMETER WITH LARGE AREA DETECTORS. C. D. Striffler (Michigan. Univ., Ann Arbor. Coll. of Engineering). Feb. 1963. Contract AT(11-1)-917. 34p.

Considerations that affect the observed data from neutron scattering experiments in which the energy and momentum transfer of the first scattering event are to be determined are discussed. Thickness of the scattering sample (necessarily thin) and the experimental environment are briefly considered. Orientation of the sample holder for greatest neutron intensity is primarily examined, and a particular arrangement is examined. Expressions describing several aspects of sample orientation are derived, and graphs display the results in some instances. (D.C.W.)

**18606** (UCRL-7067) INCREASING THE LIGHT COLLECTION EFFICIENCY OF SCINTILLATION COUNTERS. C. M. Ankenbrandt and E. M. Lent (California. Univ., Livermore. Lawrence Radiation Lab.). Oct. 1, 1962. Contract W-7405-eng-48. 25p.

A systematic study was made of methods of increasing the light collection efficiency of scintillation counters. Various reflectors, surface treatment of the scintillator, relative geometries of scintillator and photodiode, and light pipes were tried, using plastic scintillator cubes, 3 and 6 in. on a side, and right circular cylinders, 3 in. in dia. by 3 in. in length and 6 in. in dia. by 6 in. in length. The maximum factors by which light output could be increased, relative to a polished scintillator, were: about 2.8 for 6-in. scintillators and 3.3 for 3-in. scintillators without the use of light pipes, and 5.0 for a 3-in. scintillator with light pipe. The fraction of light trapped in a right circular cylinder by total internal reflection is derived as a function of index of refraction, as are the percentages of light coming out the ends and sides of a cylinder. (auth)

**18607** (UCRL-7223) MEASUREMENT OF HIGH-INTENSITY GAMMA RADIATION. C. R. Hatcher and

C. P. Jupiter (California. Univ., Livermore. Lawrence Radiation Lab.). Jan. 31, 1963. Contract W-7405-eng-48. 14p.

The use of Victoreen ionization chambers to monitor high-intensity pulsed gamma radiation is discussed. It is shown that the type 154 thimble chamber gives valid readings in pulsed bremsstrahlung fields having peak intensities as high as $5 \times 10^4$ r/sec. The Victoreen chambers may then be used to calibrate a plastic fluor-photodiode detector whose saturation level is of the order of $10^{10}$ r/sec or greater. It is demonstrated that the sensitivity of the plastic fluor detector is constant for a total received dose of $\leq 2 \times 10^5$ r. (auth)

**18608** CONTRIBUTIONS TO THE ESTABLISHMENT OF OPTIMUM OPERATING CONDITIONS WITH A WILSON CHAMBER. D. Dragomirescu, Gh. Dutescu, L. Marinescu, D. Neagu, and C. Radulescu (Institutul de Fizica Atomica, Bucharest). Acad. Rep. Populare Romine, Studii Cercetari Fiz., 13: 479-83(1962). (In Rumanian)

A 50-mm-high and 187-mm-diam. cylindrical glass chamber was used for investigating the possible improvements in the operation of the Wilson cloud chamber. A special control mechanism was constructed for the purpose of controlling carefully the amount of the expansion while differential manometers provided with electromagnetic valves served to adjust automatically the required pressures in the three reservoirs. The ion collector consisted of a vacuum-deposited Al or Cr layer on glass. The air or other gas used in the chamber was scrubbed with a concentrated $H_2SO_4$ solution before introducing it into the chamber. The expansion time of the chamber was about 50 milliseconds; it could be operated at pressures between 380 and 1140 mm of Hg. It is planned to use the improved instrument for the study of photoelectrons generated by a monochromatic x-ray beam. (TTT)

**18609** USE OF HALOGEN-TYPE GEIGER-MUELLER COUNTERS AT INTERMEDIATE CURRENT LEVELS. B. Ianculovici (Institutul de Fizica Atomica, Bucharest). Acad. Rep. Populare Romine, Studii Cercetari Fiz., 13: 787-8(1962). (In Rumanian)

In addition to normal usage, the halogen-type G-M counters may be employed at intermediate current levels. Under such conditions they present the advantage of requiring a simplified electronic system; in addition, the current of the counter is proportional to the logarithm of the dose, which makes it possible to read conveniently two decades on the scale of the instrument. If needed, a large dose range, up to 1000 r/hr, may be covered, depending on the geometric dimensions of the system. The logarithmic correlation is due to the fact that an increase of the counting rate results in an increase of the lost counts because of the dead time and a reduction of the pulse amplitude. The principle may be used for designing portable dosimeters, radiation monitors, and other high-precision instruments. (TTT)

**18610** RADIOISOTOPE INSTRUMENTATION: STANDARDIZATION AND CALIBRATION AS APPLIED TO SCINTILLATION SPECTROMETRY. Nellie M. Bering (Oscar B. Hunter Lab., Washington, D. C.). Am. J. Med. Technol., 27: 81-91(Mar.-Apr. 1961).

Procedures used in the standardization and calibration of $\gamma$-ray differential scintillation spectrometers are described, and the spectra-energy curves of the more common diagnostic radioisotopes are presented, including $Cr^{51}$, $I^{131}$, $Cs^{137}$, $Co^{58}$, $Co^{60}$, and $Fe^{59}$. A brief discussion of the standards recommended for use in the radioisotope laboratory is also presented. Some possible mechanical failures and their probable corrections are listed. Emphasis is placed on checking and rechecking all settings and connections in the detection of causes of failure. In calibration procedures, it is assumed that the results of calibration will correlate with the known spectrum-energy curve of the particular isotope. If the spectrum-energy curve does not correlate, the high voltage is redetermined and the settings of the base level, gain, and window are rechecked. If the spectrum-energy curve, after these determinations still does not correlate, then there is a mechanical problem. The interrelation of the base level, window, and gain enables choice of the best resolution and sensitivity for counting specimens. This relation is also important when it is necessary that background be reduced. Such reduction can be achieved by reducing the window and setting the base level accordingly. (H.H.D.)

**18611** THE POCKET DOSIMETER. R. E. Ryder (Rank Cintel Ltd., London). Ann. Occupational Hyg., 4: 113-18 (Dec. 1961).

Relative advantages of the pocket dosimeter and the film badge are cited and a dosimeter (Cintel-Kershaw) is described. The pocket dosimeter is the size of a fountain pen and comprises a small ionization chamber, to the inner electrode of which is attached a gilded quartz fiber in the form of a hairpin movement. It has a rubber end-cap that can be removed to enable the instrument to be charged by the now exposed electrode system. The natural leakage (leakage in absence of radiation) is so low that it is permissible to issue the dosimeters to workers in laboratories fully charged on Monday mornings, and collect them for recharging at the end of the week. The dosimeters normally have a range either from 0 to 200 or 0 to 500 Mr, but higher range instruments are available with ranges 0 to 5 r. The standard pocket dosimeter is sensitive to $\gamma$ radiation only; however, it is possible to make thin-walled chambers that are sensitive to $\beta$-radiation, but these are naturally fragile. Dosimeters sensitive to slow or thermal neutrons are similar to those described and are used in the same way except that the electrode system is coated with a small amount of boron, either natural, or enriched with $B^{10}$. Procedures for charging and reading dosimeters and protecting them from moisture, changes in temperature, and various means of accidental discharge are outlined. (H.H.D.)

**18612** PRACTICAL VIEWPOINTS ON THE APPLICATION OF RADIATION MEASURING DEVICES AND POCKET DOSEMETERS. L. Distel, G. Drexler, and F. Wachsmann (Universität, Erlangen-Nuremberg). Atompraxis, 9: 39-44 (Feb. 1963). (In German)

The radiation measuring devices and pocket dosemeters being used for radiation survey of persons and localized areas display a limited application range and unavoidable errors. The types of apparatus most frequently used are examined with regard to accuracy of indication, energy dependence, direction dependence, and the application under various working conditions. The established errors are given as directive values in form of corrective factors. (auth)

**18613** PHOSPHATE GLASS DOSIMETRY. H. J. Hardt, J. Heuser, and A. Rudloff (Bundesamt für Zivilen Bevölkerungsschutz, Bad Godesberg, Ger.). Atompraxis, 9: 45-8 (Feb. 1963). (In German)

An examination was made of phosphate glasses in regard to their usefulness for gamma dosimetry. Linearity, margin of error, directional and energy dependence, and long range reaction were tested. It was found that phosphate glass dosimetry has certain essential characteristics which make it superior to other mass dosimetry procedures. (auth)

**18614** "BIOLOGICAL" RADIATION DOSIMETRY WITH THE HELP OF A LIQUID SCINTILLATION SYSTEM. E. H. Graul and H. Hundeshagen (Philipps-Universität, Marburg, Ger.). Atompraxis, 9: 49-50(Feb. 1963). (In German)

In evaluating radiation damage, suitable "biological" radiation dosimetry is of great importance. The method must be simple and, at the same time, sensitive. Tests that were made to determine changes in the "quenching effect" through the serum of irradiated animals with the aid of a liquid scintillation counter and a special scintillation solution system are described. Characteristic differences were found in the tritium-standard measurement yield before and after irradiation with various doses of $Co^{60}$ in the $LD_{50}$ range. (auth)

**18615** THE METHOD OF NUCLEAR EMULSION AND THE PHYSICS OF ELEMENTARY PARTICLES. Pavel K. Markov. Bulgar. Akad. Nauk. Fiz. Mat. Spisanie, 5: 161-76(1962).

The chemical composition and the treatment of nuclear emulsions are discussed. The methods of identifying elementary particles (ionization tracing, multiple Coulomb scattering) and the possible applications of nuclear emulsions in the physics of elementary particles (determining the basic properties of elementary particles, studying the interaction between accelerated particles and the nucleus) are listed. (OTS)

**18616** STUDY OF TIME-TO-PULSE-HEIGHT CONVERTER. Yutaka Murata, Eiichi Arai, and Eiichi Takeda. Bull. Tokyo Inst. Technol., Spec. No. 49, 69-81(1962). (In English)

The methods for time analysis are reviewed briefly, and a time-to-pulse-height converter was developed based on the Rossi-$\alpha$ method. The specifications and circuit of the converter are described in detail. A device was developed for the simple calibration of the converter. The converter characteristics, which include linearity over the entire range, are described. (D.L.C.)

**18617** STUDY ON THE GADOLINIUM FILTER AS A NEUTRON TEMPERATURE GAGE. Eiichi Takeda, Eiichi Arai, and Ryozo Yumoto. Bull. Tokyo Inst. Technol., Spec. No. 49, 83-90(1962). (In German)

Integral methods can be used to measure a weak neutron flux if the spectrum is not hard. The principle of the methods is discussed. It is shown that Gd is better suited for neutron temperature measurements than $Pu^{239}$ and $Lu^{176}$. The manufacture and calibration of a Gd filter are considered. The temperature can be measured to ±2°C, but several problems limit the applications of the Gd filter. (D.L.C.)

**18618** TEMPERATURE DEPENDENCE OF EFFICIENCY OF LIQUID SCINTILLATORS. Shigeo Kobayashi and Sohachiro Hayakawa. Bull. Tokyo Inst. Technol., Spec. No., 49: 97-104(1962). (In English)

A method for measuring the temperature effects on energy transfer in liquid scintillators is described. The method is applied to the systems of various solutions. The results show that the light outputs of liquid scintillators decrease markedly with increasing temperature. It is known that a characteristic spectrum is obtained when a large volume liquid scintillator is excited by gamma ray radiation. A small volume scintillator in this experiment also shows a similar spectrum. (auth)

**18619** DOSIMETRIC MEASUREMENTS WITH TISSUE-EQUIVALENT IONIZATION CHAMBERS. M. Ladu, M. Pelliccioni, and E. Rotondi (CNEN, Rome). Energia Nucl. (Milan), 10: 98-102(Feb. 1963). (In Italian)

The characteristics of a tissue-equivalent ionization chamber are given; its walls are about 0.4 cm thick and the sensitive volume is about 300 $cm^3$. The sensitivity to $\gamma$ rays and neutrons vs. the pressure of the filling gas was measured. A greater sensitivity was obtained, when the chamber was filled with a tissue-equivalent gas rather than with air. Finally its characteristics were compared with those of a bakelite chamber and those of a graphite chamber; its greater sensitivity to neutrons makes it suitable for dose measurement in mixed field, especially if it is used together with the graphite chamber. (auth)

**18620** DOSE TO PHOTOGRAPHIC EMULSION DUE TO ACTIVATION OF THEIR SILVER CONTENT BY THERMAL AND EPITHERMAL NEUTRONS. T. T. Mercer and R. Golden (Naval Radiological Defense Lab., San Francisco). Health Phys., 9: 187-99(Feb. 1963).

The amount of activation by thermal and epithermal neutrons of silver in a photographic emulsion was calculated in terms of thermal neutron flux and cadmium ratio as determined by gold foils 1.27 cm in diameter by 0.0297 cm thick. The dose rate distributions around point sources of $Ag^{108}$ and $Ag^{110}$ were also calculated and used to determine the dose to a photographic emulsion resulting from activation of its own silver by thermal and epithermal neutrons. Experimental support for the calculations was obtained using Dupont Type 555 film. It was found that the dose to an emulsion due to thermal neutrons only could be expressed as $D(th) = 0.52 \times 10^{-10}\ (\overline{nvt})\ t_{Ag}$ rads, where $(\overline{nvt})$ is the average thermal neutron flux in neutrons/$cm^2$ and $t_{Ag}$ is the silver content of the emulsion in mg/$cm^2$. The ratio of the total dose to an emulsion due to both thermal and epithermal neutrons to the dose due to thermal neutrons only was obtained as a function of cadmium ratio. (auth)

**18621** DEVELOPMENTS IN NEUTRON DOSIMETRY AT A.E.R.E., HARWELL, ENGLAND. J. A. Dennis (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Health Phys., 9: 201-5(Feb. 1963).

The neutron dosimetry team at Harwell is concerned with the theoretical and experimental study of leakage spectra from reactors and critical assemblies, design of the U.K.A.E.A. criticality dosimeter, the assessment of dose in criticality accidents, experimental investigations of intermediate energy neutron spectra, and the theoretical and experimental study of the components of tissue dose. Results are presented of recent work including (a) the variation of neutron dose with depth in various tissue-equivalent phantoms, (b) dosimetry in criticality accidents, and (c) a new counter for neutrons of energy 0.4 ev to 15 kev. (auth)

**18622** A LOW ENERGY SURVEY METER. H. Maczka, J. C. Miller, K. Stuermer, and A. P. Zizos (Victoreen Instrument Co., Cleveland). Health Phys., 9: 229-31(Feb. 1963).

A very sensitive thin end-window portable ion chamber instrument was developed for measuring low intensities of x and gamma rays of energy less than 100 kev. A vibrating reed and a transistorized electrometer circuit is used to achieve high sensitivity and stability, and an anti-saturation circuit is also incorporated. The instrument covers a range of 0 to 300 mr/hr, and its spectral response is within ±10% from 30 kev to 1.3 Mev with an end cap and within ±15% from 6.5 kev to 1.3 Mev without the cap. (D.L.C.)

**18623** MEASUREMENT OF GAMMA BEAMS BY CHEMICAL MEANS. P. Tschichold and H. Mohler (Universität, Basel). Helv. Chim. Acta, 46: 173-8(1963). (In German)

The dose constant of $Ir^{192}$ was calculated from physical

measurements to be 4.997 r/mc hr. This value could be confirmed with an independent radiation chemical method, in which the concentric Minder arrangement (source in the center of a spherical measurement system) was used. (tr-auth)

**18624** SENSITIVITY OF $BF_3$ COUNTERS WITH SIMPLE PARAFFIN ARRANGEMENT. V. Meyer, J. Staub, and H. Staub (Universität, Zurich). Helv. Phys. Acta, 35: 543-6(1962). (In German)

A $BF_3$ counter arrangement for the detection and measurement of fast neutrons was described. The counter works in the proportional range. Because of the smallness of the paraffin arrangement, the sensitivity of the device depends on the energy of the incident neutrons. The sensitivity was determined using the $Li^7(p,n)Be^7$, $D(d,n)He^3$, and $T(d,n)He^4$ reactions. The sensitivity curve obtained is given and shows that the sensitivity decreases only 13% between 1 and 5 Mev and 20% between 1 and 10 Mev. (J.S.R.)

**18625** DEVELOPMENT OF A NEW TYPE OF FAST NEUTRON SPECTROMETER. C. Nussbaum, C. Lunke, and C. Zangger (Universitè, Neuchâtel, Switzerland). Helv. Phys. Acta, 35: 549-53(1962). (In French)

A fast neutron spectrometer, composed of a central scintillator and an annular scintillator, is described. The successive scattering of an incident neutron in the central scintillator and then in the annular scintillator defines a quasi-central recoil of the deuteron, and this deuteron energy is then used to measure the energy of the incident neutron with which it is in unequivocal relation. The physical and electronic principle of the spectrometer is given. Neutrons from the D-D and D-T reactions were used to calibrate the instrument. Curves obtained on $N^{14}(d,n)$ and $Li^7(d,n)$ reactions show the efficiency. A tabulation is given of the characteristics of different fast neutron spectrometers and indicates that the present apparatus is usable at high energies (6 to 20 Mev). (J.S.R.)

**18626** BASIC CHARACTERISTICS OF GM-COUNTER AND THE QUALITY OF GM-COUNTERS PRODUCED IN RESEARCH WORKS, PREMYSLENI, CZECHOSLOVAKIA. Josef Šilar. Jaderna Energie, 9: 38-45(Feb. 1963). (In Czech)

Basic characteristics of GM-counters are described from the point of view of a complete instrument. Some parameters are compared with those of scintillation detectors. The statistical dispersion of plateau length and slope, and the background is reported for instrument series produced in 1961. These values demonstrate good quality of developed counters. (auth)

**18627** MICRO-CALORIMETRIC MEASUREMENTS OF $\gamma$ RADIATION. M. Lecoin, J. Robert, and M. Picq (Université, Paris). J. Phys. Radium, 23: Suppl. No. 12, 151A-4A(Dec. 1962). (In French)

An apparatus for adiabatic micro-calorimetry, with automatic compensation, able to measure the absolute $\gamma$ radiation of radioisotopes is described. (auth)

**18628** GAS CHERENKOV COUNTER FOR ELECTRONS. Jacques Sayag (Centre d'Etudes Nucleaires, Saclay, France). J. Phys. Radium, 23: Suppl. No. 12, 169A-76A(Dec. 1962). (In French)

A gas Cherenkov counter filled with freon at atmospheric pressure is described that is able to discriminate fast electrons against pions and muons. The counter was tested in a 400 Mev/c negative beam from Saturn. Its efficiency was computed assuming a Poisson distribution for the emission of photoelectrons and the curves are compared with the experimental result. (auth)

**18629** A PROPORTIONAL COUNTER FOR EXAMINING THE LONGITUDINAL DISTRIBUTION OF RADIOACTIVITY ON THREADS OR WIRES. S. C. Ellis and J. H. Barrett (Wantage Research Lab., Berks, Eng.). J. Sci. Instr., 40: 35-7(Jan. 1963).

Radioactive threads or wires can be passed slowly through the center of the sensitive volume of the counter. A longitudinal resolution of the order of 0.5 mm is obtained. Uses of the counter include the study of the uniformity of distribution of labelled textile size or finish. (auth)

**18630** OPTIMIZATION OF THE PERFORMANCE OF A SILICON JUNCTION RADIATION DETECTOR. P. E. Gibbons (Atomic Energy Research Establishment, Harwell, Berks, Eng.). J. Sci. Instr., 40: 38-9(Jan. 1963).

The signal to noise ratio of a low-capacitance silicon junction detector may be increased by amplification with fast integrating and differentiating time constants. A simple circuit is described which enables the fast output pulse so produced to be shaped to allow correct operation of conventional pulse height analysing equipment. (auth)

**18631** AUTOMATIC SAMPLE CHANGER FOR PHILIPS LOW LEVEL BETA COUNTER UNIT. D. J. Farrell (Dominion X-ray and Radium Lab., Dept. of Health, Christchurch, New Zealand). J. Sci. Instr., 40: 76-7(Feb. 1963).

An automatic sample changer was designed that would allow the unattended evaluation of up to six individual samples, with a counting time of 3 to 15 hr each. Microswitches and a thyratron are used to effect sample changes after a preset number of radiation counts. (D.L.C.)

**18632** ADAPTATION OF A LIQUID SAMPLE SCINTILLATION COUNTER FOR DIRECTIONAL COUNTING. J. A. C. Ball (Queen's Univ., Belfast). J. Sci. Instr., 40: 81(Feb. 1963).

A collimator was designed for attachment to the photomultiplier section of a commercial liquid-sample scintillation counter for directional counting. The collimator essentially comprises two concentric brass cylinders with the annulus filled with lead. (D.L.C.)

**18633** MEASUREMENT OF THE DOSE OUTPUT DISTRIBUTION OF STRONG $\gamma$ SOURCES WITH A MICRODETECTOR CONSISTING OF PLASTIC SCINTILLATOR AND PHOTOELEMENT. C. Hamann (Instituts für Angewandte Physik der Reinststoffe, Dresden). Kernenergie, 5: 845-53(Dec. 1962). (In German)

The preparation and calibration of microdetectors were described and some examples of applications were given. The radiation resistance of the plastic scintillators used was investigated. (tr-auth)

**18634** DISCHARGE CHAMBER. SOME CONSIDERATION OF ITS CHARACTERISTICS. S. Miyamoto (Osaka City Univ.). Nuovo Cimento (10), 27: 1325-46(Mar. 16, 1963). (In English)

The characteristics of the "discharge chamber" are discussed. The unusual dependence of the electron drift velocity on the sweeping field probably explains the result that the memory time of the chamber has the minimum value at some intensity of the sweeping field. The recovery time seems to be determined by the rate of disappearance of electrons or ions produced in the discharge. The conditions of chamber operation for observing simultaneous incidence of many particles are also discussed. (auth)

**18635** SEMICONDUCTOR DETECTORS FOR NUCLEAR RADIATION. C. Kaufmann (Zentralinstitut für Kernphysik, Dresden) and R. Naumann. Phys. Status Solidi, 3: 351-82 (1963). (In German)

The design, theory, and operation of semiconductor detectors are discussed. There are two types of semiconductor detectors: with and without barrier layers. The starting material, construction, space-charge zone, lifetime of the charge carrier, efficiency as radiation detector, density of space-charge zone, capacity of space-charge zone, ionization energy, barrier current, impulses given off, and energy and time resolution of the silicon barrier layer detector are described. The preparation of surface-barrier, phosphor-diffusion, and lithium-drift detectors and those with p-n transitions produced by ion bombardment is discussed. Uses in energy spectroscopy of heavy ions and alpha particles at low energies, neutron spectroscopy, coincidence measurements, special arrangements, and integral measurements are described. (M.C.G.)

**18636** EXPERIMENTAL INVESTIGATION ON THE LIMITS OF TIME RESOLUTION OF SCINTILLATION COUNTERS. W. Bartl and P. Weinzierl (Österreichische Studiengesellschaft für Atomenergie, Seibersdorf, Austria and Universität, Vienna). Rev. Sci. Instr., 34: 252-5(Mar. 1963).

The widths of the time-resolution curves of scintillation counters (Philips 56 AVP, plastic, and stilbene scintillators) are measured as a function of the height at which the timing pulse is derived from the rising edge of the scintillation pulse. A very small fraction of this leading edge is used to create a timing signal in a biased two-stage limiter circuit. The arrangement agrees closely with a timing method discussed by Gatti and Svelto and the results are compared to their theoretical predictions. (auth)

**18637** RESPONSE OF SEMICONDUCTOR DETECTORS TO FISSION FRAGMENTS. H. C. Britt and H. E. Wegner (Los Alamos Scientific Lab., N. Mex.). Rev. Sci. Instr., 34: 274-7(Mar. 1963). (LADC-5154)

Measurements with a $Cf^{252}$ spontaneous fission source showed that semiconductor detectors exhibit a pulse-height defect for fission fragments, and that this defect is greater for the low-energy, heavy-mass group than for the high-energy, light-mass group. It is also shown that the defect decreases with increasing bias voltage or average electric field strength within the depletion region. However, for a given electric field strength, the defect was found to be approximately independent of the type and resistivity of the detector. These results are consistent with the hypothesis that the pulse-height defect arises from an inability to collect all of the hole–electron pairs in the dense plasma produced by an energetic fission fragment. (auth)

**18638** SMALL FIVE-CHANNEL PULSE-HEIGHT ANALYZER. C. D. Swift (Univ. of California, Livermore). Rev. Sci. Instr., 34: 306-7(Mar. 1963). (UCRL-7147)

A five-channel analyzer is described which can be mounted on a printed circuit card and accepts negative signals from the anode of a photomultiplier tube. The power required is only 70 mw. The operation of the analyzer is described. (D.L.C.)

**18639** OPERATING CONDITIONS OF BUBBLE CHAMBER LIQUIDS. P. Spiegler, J. Hopenfeld (Atomics International, Canoga Park, Calif.) and A. Norman. Rev. Sci. Instr., 34: 308-9(Mar. 1963).

It is desirable to predict the foam limit in order to optimize the operating conditions of the bubble chamber. It is shown that the van der Waals equation of state in reduced coordinates predicts foam limits that are in close agreement with the actual operating conditions. (D.L.C.)

**18640** THE IONIZATION CHAMBER PULSE DISTORTIONS BY AMPLIFIER. N. N. Dmitrieva and V. A. Dmitriev. Vestn. Mosk. Univ., Ser. III, Fiz. Astron., No. 6, 7-10(Nov.-Dec. 1962). (In Russian)

Amplifier-induced pulse distortions resulting in variable ionization distribution in ionization chambers were analyzed. Pulse distortion amplitudes are correlated with pulse duration and amplifier constants. Large amplitude distortions were observed in amplifiers with nonlinear amplitude characteristics. (R.V.J.)

**18641** THE DETECTION OF IONIZING RADIATION WITH EXOELECTRONS. Johannes Kramer (Physikalisch-Technische Bundesanstalt, Brunswick). Z. Angew. Phys., 15: 20-8(Jan. 1963). (In German)

The spontaneous and stimulated exoelectron emission was measured in various materials after exposure to x radiation and charged particles. The irradiation time and radiation output were varied. Excitation through the "zero effect" gives a measurable emission. The reciprocity law is valid in the irradiation. The life of the excited states for the stimulated emission is more than 30 days. The effect of temperature before and after irradiation on the emission is negligible only when the number of bond sites remain constant. Substances with high atomic number are suitable for the detection of penetrating radiation. The K and L absorption boundaries of the samples affect the emission. (tr-auth)

**18642** BETA SPECTROMETERS WITH DEFLECTION ANGLES $\pi/2\sqrt{13}$ and $\pi\sqrt{2}$. Jost O. Trier. Thesis, Marburg, Ger., Universität, 1961. 76p. $2.00; 8 DM.

Several types of flat magnetic beta spectrometers with symmetrical field, high resolution, and high transmission can be conceived for which the resolution is not influenced by the errors of the second order. They all give strongly astigmatic images of curved sources on a curved target. The focusing angle for these spectrometers is larger than $2\pi$ with an exception for one type in which it has the value of $\pi/2\sqrt{13}$. The image errors of the third order were determined for this system. A comparison of the $\pi/2\sqrt{13}$ spectrometer with the $\pi\sqrt{2}$ spectrometer demonstrates that most of the errors of this instrument can be avoided. The transmission was determined for several types of spectrometers. An example demonstrates that in the high resolution region the $\pi/2\sqrt{13}$ spectrometer has a transmission which is 5 to 8 times higher than that of the $\pi\sqrt{2}$ spectrometer. (Gmelin Inst)

**18643** A NEW METHOD FOR SEPARATING PULSES FROM FAST NEUTRONS AND GAMMA QUANTA. G. G. Doroshenko and E. L. Stolyarova (Academy of Sciences, Moscow). IAEA Preprint SM-36/16. 9p. (In Russian)

To be published in Proceedings of the IAEA Symposium on Neutron Detection, Dosimetry and Standardization, Harwell, United Kingdom, December 10-14, 1962.

A new method of pulse separation in a scintillation detector is described, based on the different effective scintillation decay times for different types of exciting particles and on the use of the photomultiplier under special highly saturated conditions. These latter conditions make it possible to obtain short pulses (~0.2 μsec) at the output of the photomultiplier, their amplitude being determined solely by the effective scintillation decay times. Results of experiments to produce a state of high saturation in the photomultiplier are given, and effective scintillation decay times are evaluated. Experimental results are given confirming the existence of the separation effect. A diagram of a fast neutron counter based on the separation method described is given together with its main characteristics. (auth)

**18644** A MODIFIED PROCEDURE FOR USING THE HURST-TYPE PROPORTIONAL COUNTER FOR DOSIME-

TRY OF MIXED GAMMA-NEUTRON RADIATION. V. I. Ivanov. IAEA Preprint SM-36/17. 11p. (In Russian)

To be published in Proceedings of the IAEA Symposium on Neutron Detection, Dosimetry and Standardization, Harwell, United Kingdom, December 10-14, 1962.

The possibilities of measuring the integral dose of mixed gamma-neutron radiation and calculating relative biological effectiveness using a proportional counter with tissue-equivalent walls are discussed. The underlying principle of this method is that the pulses caused by recoil protons and electrons are channelled along different paths in the electronic circuit. The value registered on the output is proportional to the sum of pulse amplitudes. The RBE is calculated electronically. The minimal error conditions are considered; the sensitivity of the method is evaluated and practical recommendations are given. (auth)

**18645** THE SPECTROMETRIC METHOD AND THE ATTENUATION CURVE ANALYSIS METHOD FOR DETERMINING THE ACTIVITY OF THRESHOLD INDICATORS. V. P. Mashkovich. IAEA Preprint SM-36/18. 11p. (In Russian)

To be published in Proceedings of the IAEA Symposium on Neutron Detection, Dosimetry and Standardization, Harwell, United Kingdom, December 10-14, 1962.

A spectrometric method and a method of attenuation curve analysis are described for determining the activity of radioactive threshold indicators in cases when the half-life of the activities of accompanying reactions is near or equal to the half life of the basic activity. These methods of determining the activity of indicators can very often be used to measure fast neutron fluxes in intense thermal and intermediate neutron flux fields. The attenuation curve analysis method makes it possible to introduce a correction to the count due to the activation of foreign substances in an intense thermal and intermediate neutron flux ($10^6$ intermediate neutrons to 1 fast neutron). This method can be used to introduce similar corrections when working with fission chambers. Both methods are used to measure the activity of threshold indicators for the reaction $Al^{27}(n,\alpha)Na^{24}$. (auth)

**18646** SOLID-STATE FISSION COUNTERS. D. Strominger (Atomics International, Canoga Park, Calif.). IAEA Preprint SM-36/89. 15p. (In English)

To be published in Proceedings of the IAEA Symposium on Neutron Detection, Dosimetry and Standardization, Harwell, United Kingdom, December 10-14, 1962.

Solid-state p-n silicon junction counters have been fabricated to measure fission rates of materials with different fission thresholds. The threshold for neutron-induced fission in these materials varies from thermal energies for $U^{235}$ to 1.5 Mev for $Th^{232}$. The data gathered from these solid-state fission counters have been used to determine neutron spectra and to compare experimental with calculated fission rates in the AETR cores. Results agree well with calculated values. A commercial p-n junction solid-state detector was used as the active element of each fission counter. The fission counters were assembled by placing an electroplated foil of a fissionable material in close proximity to window of the p-n junction detector. An aluminum cap was placed over each detector and foil to form a neat, compact assembly. The resulting counter is small enough to fit inside a reactor with minimum distortion to the neutron spectrum. The fission counters were calibrated by determining the alpha counting rate of each foil once it was locked to its detector in its aluminum assembly. Since each fissionable material is an alpha emitter with a well-known decay constant, the "effective" mass of the material can be calculated from the alpha counting rate and the half-life of the particular material. In addition, some of the counters were cross-calibrated in a thermal neutron flux by counting fission fragments. The two methods agreed well. The counters have proved stable for experiments lasting from two to five hours in fluxes $\leq 10^8$ nv. Because there are two fission fragments associated with each fission, the solid-state detector has about one-half the geometric efficiency for alpha disintegrations as it has for fission events. The scattering properties of fission fragments and alpha particles are somewhat different, therefore the ratio of efficiencies is not exactly one-half. This uncertainty cancels out when measuring the fission-counting ratios of different materials because all the counters have the same error. Fission counters employing $Th^{232}$, $U^{233}$, $U^{234}$, $U^{235}$, $U^{236}$, $U^{238}$, $Np^{237}$, and $Pu^{239}$ as the principal fissionable material have been successfully fabricated. These solid-state fission counters have proved reliable instruments to measure fluxes in high gamma ray fields. True fission events are easily separated from other induced reactions in the counter. (auth)

**18647** NEUTRON DIFFRACTION SPECTROMETER, M II (Engineering Materials). (Argonne National Lab., Ill.). (CAPE-890)

A crystal spectrometer was designed that has a tapered collimator that extends into the reactor for surveying the most intense region of neutron flux. The neutrons pass through the collimator to the crystal. Monochromatic neutrons from the crystal next pass through defining slits to the sample and then to the detector. This spectrometer is often used in tandem with the neutron diffractometer M I (see CAPE-891). There are 449 units in this CAPE package. (F.E.S.)

**18648** DEVICE FOR DETERMINING THE DEPTH OF A RADIATION SOURCE WHILE SCANNING THE DISTRIBUTION OF THE RADIATION INTENSITY OF RADIOACTIVE TRACERS. W. Horst (to Siemens-Reinger-Werke-Aktienges). German Patent DAS 1,143,276. Feb. 7, 1963. Filed Mar. 11, 1960.

The device described is designed to use two radiation detectors with two collimating systems between the object and the detectors, the detectors being located on two opposite sides of the object pointing in opposite directions along the same axis. The collimating systems are of the focusing type consisting of a series of tapered apertures aimed at a focal spot. The two collimating systems have one common focal point which lies on the axis of the whole device. The location of this common focal point on the axis can be varied by applying a set of collimators with different tapering and interchanging them. (Gmelin Institute)

**18649** MAGNETIC SPECTROMETER WITH A FOCUSING LENS SYSTEM PRIOR TO THE ENERGY SEPARATION MEANS. Harald A. Enge (to High Voltage Engineering Corp.). U. S. Patent 3,084,249. Apr. 2, 1963. Filed Oct. 1, 1959.

A magnetic spectrometer is designed which is a combination of a high-resolution, small-aperture energy-separating magnet with a strong lens such as a quadrupole lens or a sector lens. (D.L.C.)

**18650** RADIATION SENSITIVE SYSTEM. Joris M. Brinkerhoff and Richard L. Bersin (to Lab. for Electronics, Inc.). U. S. Patent 3,084,255. Apr. 2, 1963. Filed Nov. 13, 1958.

A sensitive, nonambiguous gas monitor is designed which is especially suited for determining the tritium concentration in air. The monitor includes three serially connected

chambers through which the gas to be monitored is passed. The first chamber has a filter and electrodes for removing all particulate matter and pre-existing ions. The second chamber serves as a hold volume for the accumulation of ions created by the radioactivity in the gas prior to counting in the third chamber. A modification of the monitor for monitoring large physical objects such as clothing or ore is also described. (D.L.C.)

# ISOTOPE SEPARATION

**18651** (WSEG-RM-24) CONTEMPORARY ULTRACENTRIFUGES AND ISOTOPIC SEPARATION. An Appraisal. Herbert O. Horn (Weapons Systems Evaluation Group. Inst. for Defense Analyses, Washington, D. C.). Aug. 1, 1962. 38p.

An appraisal of recent improvements in the construction and efficiency of ultracentrifuges for the separation of isotopes is presented. The use of ultracentrifugation from both a technical and economic standpoint not only for the United States and the smaller non-nuclear nations, but also in the light of current international discussions on disarmament is discussed. Three types of centrifuges, concurrent, evaporative, and countercurrent, are described in detail and compared. The use of centrifuges for isotope separation is not economically possible at present; highly enriched material produced by this method would result in prices ~75% higher than current U. S. prices. However, the centrifugation process might be attractive to smaller nations due to relatively low investment cost resulting from a short cascade length and the modular nature of construction. In light of recent German advances in ultracentrifugation and the implications that follow from them, this process warrants detailed and continuing consideration. (H.G.G.)

**18652** (AEC-tr-5712) CONTRIBUTION TO THE STUDY OF THE FLOW OF ADSORBED PHASES. ENRICHMENT OF BINARY GAS MIXTURES (thesis). Jean Claude Sapet (Lyon. Universite). Translated for Oak Ridge Gaseous Diffusion Plant, Tenn. Dec. 1962. 77p.

Static methods of investigation of the absorbed phase do not permit a prediction of all of the effects due to a dynamic regime such as permeability of microporous solids with respect to vapors and enrichment effects by the flow of absorbates. The permeability minima of a porous substance with respect to a condensable vapor for a relative pressure corresponding to a monolayer is explained both by hydrodynamic considerations regarding the gaseous phase and by thermodynamic considerations regarding the absorbed phase either in terms of a pore radius reduction or a solidification of the absorbate. The numerous configuration possibilities of the absorbed phase preclude the application of relations capable of accounting for the phenomena as a whole. The influence of the flow of absorbates on the separative effect of gaseous diffusion membranes is discussed. The experimental investigation based on hydrocarbons reveals the essential role of the molecular structure in the surface mobility of molecules. The enrichment observed with the mixture of $H_2O-DHO$, under experimental conditions where only the absorbate is involved, is attributed to the different molecule-solid interaction and thus to a different specific mobility of the $H_2O$ and the DHO molecules. (H.G.G.)

**18653** ANALYTICAL SEPARATION OF HYDROGEN ISOTOPES BY GAS-SOLID ELUTION CHROMATOGRAPHY ON CAPILLARY COLUMNS. Colette Cercy, Serge Tistchenko, and Fernande Botter (Centre d'Etudes Nucléaires, Saclay, France). Bull. Soc. Chim. France, No. 11-12, 2315(Nov.-Dec. 1962). (In French)

The analytical isotopic separation of a $H_2-HD-D_2$ mixture was made by gas-solid elution chromatography using helium as carrier on a capillary column filled with alumina. The operating conditions are described, and the retention volumes, separation factors, and limits of detection are given. (J.S.R.)

**18654** SEPARATION OF ISOTOPE MIXTURE BY NOZZLE PROCESS. Hisashi Mikami and Yoshitoshi Oyama. Bull. Tokyo Inst. Technol., Spec. No. 49, 167-80(1962). (In English)

It was recently discovered by E. W. Becker and his coworkers that an isotope gas mixture could be separated in a supersonic flow of jet. The separation may be due to pressure diffusion caused by the radial pressure gradient in the vicinity of the nozzle opening when the Knudsen number Kn is much smaller than $10^{-1}$. When $Kn > 10^{-1}$, on the other hand, it may be explained in terms of free molecular effusion of gas mixture at the nozzle opening, but in the intermediate regime, $Kn \approx 10^{-1}$, theoretical treatment is difficult. First, the correlation of separation effect $\epsilon_A$ and cut $\eta$ was given by equations and derived from the kinetic theory of gas, on the assumption that gas mixture effuses as free molecular flow. The values calculated by the equations were in fairly good agreement with those experimental data which were obtained by Becker, et al. when the nozzle inlet pressure was maintained to be 30 mm Hg. Second, the separation effect was calculated in the Prandl-Meyer flow which was the most simple solution of the equation of motion in the case where the gas can be regarded as a continuous medium. The separation effect in the form of a function of the distance d calculated from the equations is shown in comparison with experimental data obtained by Becker, et al. (auth)

**18655** THE SEPARATION FACTOR OF LITHIUM ISOTOPES WITH ION EXCHANGERS. H. Kakihana, T. Nomura, and Y. Mori (Tokyo Inst. of Tech.). J. Inorg. Nucl. Chem., 24: 1145-51(Dec. 1962).

Fundamental equations for the isotopic ion exchange reaction were derived with various degrees of approximation considering the various kinds of external solutions and ion exchangers. The separation factors of lithium isotopes $S_{Li}^{Li}$ in ethanol (or acetone)–water mixtures were determined with differently cross-linked sulfonated polystyrene-divinylbenzene copolymers and synthetic inorganic ion exchanger Ionite C (zirconium phosphate type). LiOH systems gave higher separation factors than LiCl systems. The highly cross-linked resins and synthetic inorganic ion exchanger are also favorable for the higher separation factor. The highest value 1.022 was obtained for the system of 0.1 M LiOH 20 per cent acetone–water mixture using synthetic inorganic ion exchanger. These experimental results were analyzed by fundamental equations. (auth)

**18656** ON THE POSSIBILITY OF USING $NO-H_2O$ ISOTOPE EXCHANGE IN NITRIC ACID SOLUTIONS FOR CONCENTRATING $^{18}O$. E. D. Oziashvili, Yu. V. Nikolaev, and N. F. Myasoedov. Soobshch. Akad. Nauk Gruz., 29: 289-92 (1962).

During isotope exchange between NO and $H_2O$ in 8M $HNO_3$, $N^{15}$ was concentrated in the liquid phase and $O^{18}$ in the gaseous phase. An apparatus was constructed in which NO was decomposed into N and O above 700°C using a catalyst and the O recombined with additional NO to form $NO_2$. Simultaneous operation of $N^{15}$ and $O^{18}$ concentrators yielded highly concentrated $N^{15}$ (>99%) and O containing ~15% $O^{18}$. (P.C.H.)

**18657** GAS AND ISOTOPE SEPARATION IN A VORTEX TUBE. K. Bornkessel and J. Pilot (Bergakademie, Freiberg/Sa, Ger.). Z. Physik. Chem. (Leipzig), 221: 177-84 (1962). (In German)

The Ranque-Hilsch vortex tube was used for gas and isotope separation. Air, whose $O_2-N_2$ ratio was determined before and after passage through the tube, was the test gas. Mass spectrometric isotopic frequency analyses were carried out on nitrogen, argon, and hydrogen. In all cases, the heavier components were enriched in the central colder partial current. The dependence of the separation effect on various parameters (distance between inlet and nozzle, intake pressure, and ratio of the warm and cold partial currents) was investigated. (tr-auth)

# MATHEMATICS AND COMPUTERS

*Refer also to abstract 18179.*

**18658** (HW-61265) LLESQS—IBM 709 PROGRAM FOR CALCULATION OF LEAST SQUARES. R. A. Bennett, and M. Brown (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Aug. 10, 1959. Contract AT(45-1)-1350. 10p.

A linear, weighed, least-squares analysis program was prepared for the IBM-709 computer. The form of the fitted equation is $y = a + b(x - \bar{x})$. The code will fit data to any equation which is reducible to this linear form. The special case of $y = Ce^{bx}$ is built into the code and may be selected by a simple statement in the input data. This code may be used in multiple least-square analysis. This application is true of any least-square code providing the residual sum of squares is available. The program can handle successive problems without rereading the program deck. The output data can be recorded on tape for subsequent printing or printed directly from the computer. (H.G.G.)

**18659** (KAPL-M-FDF-2) SWAKRAUM—A SPATIALLY DEPENDENT THERMAL SPECTRUM CODE FOR THE PHILCO-2000. Francis D. Federighi (Knolls Atomic Power Lab., Schenectady, N. Y.). Nov. 1962. Contract W-31-109-eng-52. 49p.

SWAKRAUM is a general one-dimensional, thermal space-energy code which calculates the thermal spectrum, cross-sections averaged over the spectrum, and the thermal flux as a function of position. The calculation is based on either a P-1 or Double P-1 expansion of the Boltzmann Equation. The $P_0$ component of the energy exchange kernel may be any scattering kernel, but the $P_1$ component must contain no energy transfer (e.g., Radkowsky prescription). The code assumes that the spectrum everywhere can be represented as a linear combination of a few spectra (the "trial spectra"). The code has a built-in blackness routine, so that calculations may treat discrete poison plates and control rods by thin region theory. The output of the code includes, at each point, the spectrum, the spectrum averaged materials constants, the flux, and the energy integrals of the product of various cross sections and the flux. (auth)

**18660** (NAS-NS-3107) APPLICATIONS OF COMPUTERS TO NUCLEAR AND RADIOCHEMISTRY. PROCEEDINGS OF A SYMPOSIUM, GATLINBURG, TENNESSEE, OCTOBER 17-19, 1962. G. D. O'Kelley, ed. (Oak Ridge National Lab., Tenn.). 323p.

"Nuclear Science Series" of the National Research Council. Committee on Nuclear Science.

All papers and a panel discussion on computer applications presented at the symposium are collected in a single volume. A total of twenty-five papers are included. (J.R.D.)

**18661** (ORNL-TM-430(Suppl.)) AN IBM-7090 SUBROUTINE FOR MAKING LINEAR GRAPHS USING THE CALCOMP PLOTTER. D. K. Trubey and M. B. Emmett (Oak Ridge National Lab., Tenn.). Feb. 27, 1963. Contract [W-7405-eng-26]. 4p.

An IBM-7090 subroutine has been written to facilitate the plotting of curves and points on linear graphs using the CALCOMP plotter. The subroutine must be used in conjunction with the subroutine package described in ORNL-TM-430. (auth)

**18662** (RM-2888-PR) VARIATIONAL METHODS IN PROBLEMS OF CONTROL AND PROGRAMMING. Leonard D. Berkovitz (RAND Corp., Santa Monica, Calif.). Dec. 1961. 50p. Contract AF49(638)-700.

The process of reducing a fairly general control problem, or programming problem, with constraints, to a special type of classical Bolza problem in the calculus of variations is described. Necessary conditions from the Bolza problem are translated into necessary conditions for optimal control. It is seen from these conditions that Pontryagin's maximum principle is a translation of the usual Weierstrass condition, and is applicable to a wider class of problems than that considered by Pontryagin. The differentiability and continuity properties of the value of the control are established under reasonable hypotheses on the synthesis, and it is shown that the value satisfied the Hamilton-Jacobi equation. As a consequence, a rigorous proof of a functional equation of Bellman is obtained and is shown to be valid for a much wider class of problems than heretofore considered. A sufficiency theorem for the synthesis of control is also given. (auth)

**18663** (TID-18446) PROGRESS REPORT NO. 29 [ON COMPUTING AND MATHEMATICS], JULY 1, 1962–DECEMBER 31, 1962. Arthur Melmed (New York Univ., New York. Courant Inst. of Mathematical Sciences). Jan. 21, 1963. Contract AT(30-1)-1480. 23p.

Work is being carried out on the development of a non-destructive read mode for magnetic-core memories, and the development of a character-reading machine having the capacity to identify hand-printed alpha-numeric characters as they commonly appear, say, on FORTRAN coding sheets. The development of a reliable non-destructive read (NDR) mode will make possible read speeds (using magnetic cores) comparable to those obtainable with magnetic thin-films. This would be a significant achievement in view of the reduced requirements placed by cores upon an already stressed and stretched peripheral electronics. In additional, a NDR mode is an indispensable minimal operational requirement for an associative memory. The application of what is learned to extending the list of non-arithmetic-oriented functions currently found in existing computers is discussed. (auth)

**18664** (WCAP-2059) CAT II—AN IBM 7090 CODE FOR PREDICTING THERMAL AND HYDRAULIC TRANSIENTS IN AN OPEN-LATTICE CORE. R. O. Sandberg (Westinghouse Electric Corp. Atomic Power Div., Pittsburgh). Aug. 1962. 78p.

CAT II is a digital computer code designed specifically to predict the thermal and hydraulic performance of rod type, open-channel reactor cores. The code is primarily intended for calculating thermal and hydraulic transients associated with a loss of coolant flow accident, although it has also been used extensively for steady state calculations. (auth)

**18665** (Y-1400) CUBIC SPLINE, A CURVE FITTING ROUTINE. A. H. Fowler and C. W. Wilson (Union Carbide Nuclear Co. Y-12 Plant, Oak Ridge, Tenn.). Sept. 5, 1962. Contract W-7405-eng-26. 86p.

A method of mathematically fitting a curve through a given ordered set of points was developed and programmed in fortran computer language. The fitted curve, which is made up of a series of normalized cubic polynomials, very

nearly approximates the curve generated by passing an infinitely thin spline through the sets of points and is, therefore, called a "cubic spline". The curve has the properties of continuous position, slope, and curvature. The restraints placed upon the cubic spline may be relaxed by applying an additional feature which permits the points to be adjusted by, at most, some preset value. This has the effect of smoothing the curve in the sense that it reduces the strain energy stored in it while preserving the general shape of the curve. Tool centers for numerically controlled tools are found with the interpolation and offsetting methods included. (auth)

**18666** THE GENERALIZED ASYMPTOTIC SERIES. Stanisław Pruski (Nicholas Copernicus Univ., Toruń, Poland). Acta Phys. Polon., 22: Suppl., 25-34(1962). (In English)

An analysis of functions that vanish sufficiently strongly at infinity was carried out. It was shown that such functions, if made to depend in an appropriate way on an additional parameter, may be represented by series formed of the derivatives of Dirac's $\delta(x)$ function. Because of their properties they were called the generalized asymptotic series. They allow one, in many cases, to derive the ordinary asymptotic expansions for special functions of physics from their integral transforms. The theory is also intended to serve as the asymptotic theory of source functions. It is supposed that, when extended to many dimensions, it may prove a valuable tool in nonlocal theories. (auth)

# METALS, CERAMICS, AND OTHER MATERIALS

## General and Miscellaneous

*Refer also to abstract 18466.*

**18667** (AAEC/E-102) PREPARATION OF THE BERYLLIDES OF URANIUM AND THORIUM. G. L. Hanna and D. N. Turner (Australia. Atomic Energy Commission Research Establishment, Lucas Heights, New South Wales). Jan. 1963. 16p.

UBe and ThBe and their solid solutions were prepared by reaction-sintering, reaction-pressing and arc-melting of mixed metal powders. The major difficulties of preparation were the large swellings accompanying reaction without pressure and the loss of Be at temperatures above 1200 to 1300°C. The reaction-pressing method suffered least from these difficulties and yielded the purest and most dense products. (auth)

**18668** (AFOSR-2647) ON THE POSSIBILITY OF FORMING PSEUDO SILICIDES. Technical Status Report (Report No. 5), January 1, 1962–September 31, 1962. H. Boller and E. Parthé (Pennsylvania. Univ., Philadelphia. School of Metallurgical Engineering). Sept. 1962. Contract AF49(638)-1027. 12p. (AD-284058)

The concept of pseudosilicon is very successful for the prediction of occurrence and structure of certain groups of nonmetallic compounds. Experiments to extend this concept to metallic compounds show that the concept has to be modified. The extremely narrow homogeneity range observed in compounds composed as pseudosilicon or nonmetallic pseudosilicon oxide is replaced by wide ranges which may extend far from the ideal composition of the pseudosilicide. Close to the composition of the pseudosilicide, a chemical stabilization and a volume contraction may be observed. Two true pseudosilicides were synthesized: $Hf_5(In_{0.5}Sb_{0.5})_3$ with $D8_8$ structure; a = 8.46 Å, c = 5.79 Å, and c/a = 0.684 and $Mo(Al,P)_2$ with $C_{40}$ structure; a = 4.76 Å, c = 6.64 Å, and c/a = 1.40. Results are further reported on the following cuts: $Nb_3Al-Nb_3Sb$, $Nb_3Ga-Nb_3Sb$, $Nb_3In-Nb_3Sb$, $(Zr_5Al_3)-Zr_5Sb_3$, $Zr_5Ga_3-Zr_5Sb_3$, $(Zr_5In_3)-Zr_5Sb_3$, and $Ti_5Ga_3-(Ti_5Sb_3)$. (auth)

**18669** (ASD-TDR-62-1026) ANNOTATED BIBLIOGRAPHY ON SOLID STATE OPTICAL AND INFRARED MASER MATERIALS. (A Summary of Abstracts from Current Literature up to December 1961). Dieter Feldmann (Aeronautical Systems Div. Physics Lab., Wright-Patterson AFB, Ohio). Nov. 29, 1962. 33p.

Abstracts of approximately 110 articles from 25 different scientific journals are presented. It covers theory and survey; solid state maser materials; maser optics; properties (coherence and others); related basic research; and organic, semiconducting, and gas masers. The survey includes articles from the beginning of the optical maser research to December 1961. (auth)

**18670** (BBC-108) DEVELOPMENT OF INTERMETALLIC COMPOUNDS FOR VERY HIGH TEMPERATURE APPLICATIONS. Quarterly Progress Report, May 1–July 31, 1960. R. M. Paine, A. J. Stonehouse, L. Owens and W. W. Beaver (Brush Beryllium Co., Cleveland). Aug. 15, 1960. Contract AT(30-1)-541. 33p.

Progress in the development of intermetallic compounds between beryllium and certain transitional elements is described. Work was continued on mixed-phase compositions in the Ta–Be and Zr–Be systems. The effect of impurities in raw materials and their disposition during processing of intermetallic compounds is described. Modulus of rupture tests, hardness measurements, and thermal shock data are also included. Preliminary studies of the compatibility of beryllides with common materials of reactor construction commenced during this period. Studies of the fabrication of $ZrBe_{13}$ by cold pressing and sintering continued. (auth)

**18671** (BNL-788) HIGH-TEMPERATURE LIQUID-METAL TECHNOLOGY REVIEW. A Bimonthly Technical Progress Review. Vol. 1, No. 1. O. E. Dwyer, ed. (Brookhaven National Lab., Upton, N. Y.). Feb. 1963. Contract [AT(30-2)-Gen-16]. 31p. (BNL-PR-1)

Unclassified technical reports and papers in the high-temperature liquid-metal field are reviewed. All phases of liquid-metal technology pertinent to the space power development program are covered, including materials development, corrosion, heat transfer, fluid dynamics, instrumentation, component development, physical properties, and power systems. Twelve reviews are included. (M.C.G.)

**18672** (NAA-SR-7752) A METHOD FOR DIFFERENTIATING BETWEEN MATERIALS CONTAINING NORMAL AND FULLY ENRICHED URANIUM. R. C. Barry and A. R. Mooers (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Apr. 15, 1963. Contract AT(11-1)-Gen-8. 16p.

When normal U and fully enriched U are used in the same research, development, or manufacturing area, the possibility always exists that chips, shavings, scrap, fuel rods, and even fuel elements may not be properly identified or may lose their identity. A system was developed which will allow rapid determination of the enrichment of U–Zr alloys or unalloyed U metal. This autoradiometric system is based on the fact that the $U^{238}$ decay chain includes the emission of a 2.31-Mev beta particle which is more easily absorbed by an Al filter than gamma photons emitted during the decay of $U^{235}$. The instrumentation required and the procedures employed for the identification of normal or fully enriched U–Zr alloys or unalloyed U metal are described. The procedures described should be readily adaptable to other U-bearing compounds and alloys. (auth)

**18673** (SB-62-58) COMPOSITE MATERIALS: AN ANNOTATED BIBLIOGRAPHY. Helen M. Abbott, comp. (Lockheed Missiles and Space Co., Sunnyvale, Calif.). Feb. 1963. 93p.

An annotated bibliography of 190 selected references pertaining to composite materials is presented. Material composites are broadly considered as physical combinations of two or more dissimilar materials. Boron carbide impregnated with aluminum (Boral), metal fibers in glass or plastics, or glass fibers in Al are examples of some of the various combinations that are being studied. Sandwich materials were not included in the search, although few fabricated articles cannot in some way be referred to as composites. Space flight and supersonic aircraft have made great demands for ingenious composites. (auth)

**18674** (UCRL-5705) CURRENT BERYLLIUM LITERATURE; A SELECTED BIBLIOGRAPHY, JANUARY 1958–AUGUST 1959. Zanier D. Lane (California. Univ., Livermore. Lawrence Radiation Lab.). Sept. 29, 1959. Contract [W-7405-eng-48]. 33p.

A bibliography of selected articles on beryllium which have appeared in journals received in the library of LRL, and articles, reports, and books which have appeared in abstracting services between Jan. 1958 and Aug. 1959 is presented. The bibliography is divided into six sections: beryllium bibliographies; chemistry of beryllium; nuclear reactions of beryllium; production, properties, fabrication, and applications of beryllium; toxicity and handling of beryllium; and beryllium oxide. (H.G.G.)

**18675** (UCRL-5705(Suppl.1)) CURRENT BERYLLIUM LITERATURE: A SELECTED BIBLIOGRAPHY, AUGUST 1959–DECEMBER 1960. Zanier D. Lane (California. Univ., Livermore. Lawrence Radiation Lab.). May 1, 1961. Contract W-7405-eng-48. 55p.

A bibliography of selected books, articles, and unclassified reports on beryllium which appeared in abstracting services between Aug. 1959 and Dec. 1960 is presented. The bibliography is divided into seven sections: general references and bibliographies; chemistry of beryllium; physics of beryllium; beryllium isotopes; beryllium alloys, compounds, and systems; toxicity and handling; and reactor applications. Books and articles are arranged alphabetically by author and the reports are arranged by report number. Sources for the references are noted at the end of the entries. (H.G.G.)

**18676** (UCRL-5705(Suppl.2)) CURRENT BERYLLIUM LITERATURE: A SELECTED BIBLIOGRAPHY, JANUARY 1961–DECEMBER 1962. (California. Univ., Livermore. Lawrence Radiation Lab.). Jan. 1963. Contract W-7405-eng-48. 351p.

A bibliography of selected literature on beryllium gathered from the world's leading journals, books, technical reports, dissertations, and patents during the period Jan. 1961 through Dec. 1962 is presented. The bibliography is divided into five sections: chemistry of beryllium, physics of beryllium, beryllium compounds, beryllium oxide, and beryllium metallurgy. In each section, books and journals appear first, arranged alphabetically by author. Anonymous articles are arranged alphabetically by journal name at the end of each grouping. These are followed by reports and patents arranged by report numbers. Translations are located in the groupings in accordance with their original form. Some references are located in more than one section because of diversity of subject content. (H.G.G.)

**18677** (UCRL-10311) THE 1962 HORACE W. GILLETT MEMORIAL LECTURE ON "PROGRESS IN UNDERSTANDING HIGH-TEMPERATURE CREEP." John E. Dorn (California. Univ., Berkeley. Coll. of Engineering and California. Univ., Berkeley. Lawrence Radiation Lab.). [July 1962]. Contract [W-7405-eng-48]. 53p.

Progress to date in the understanding of high-temperature creep is discussed. A theory for the description of the component of creep arising from the thermally activated motion of jogged screw dislocations in pure metals, which agrees with the experimental facts at ~ one-half of the melting temperature, is explored. As creep continues, some dislocation sources become blocked as a result of the back-stress fields of interacting edge dislocations. Climb of such blocked dislocations can result in a second component of creep. Hence, both motion of jogged screw dislocations and the climb of edge dislocations contribute to total observed creep. The activation enthalpy for the motion of jogged screw dislocations is < the activation enthalpy for diffusion, but that for climb is slightly > that for self-diffusion. The mean value should approximate that for self-diffusion as is observed experimentally. (H.G.G.)

**18678** (AEC-tr-5711) MANUFACTURING, PROPERTIES, AND APPLICATIONS OF SOME HIGH-TEMPERATURE OXIDE MATERIALS. Walter Richter and Karl Pump. Translated by Anne C. Foell (Phillips Petroleum Co., Idaho Falls, Idaho) from Silikat Tech., 9: 74-7(1958). 20p. (Includes original, 4p.).

A survey of the methods of processing and of the technically important properties of high-temperature materials such as $ZrO_2$, CaO, MgO, BeO, $Al_2O_3$, and ThO is presented. The present fields of applications for this group of materials are discussed. (H.G.G.)

**18679** (FTD-TT-62-1473) POWDER METALLURGY (SELECTED ARTICLES). Translated from Poroshkovaya Met., Akad. Nauk Ukr. SSR, No. 4, 63: 86-102(1961).

Translations of four selected articles are included; separate abstracts have been prepared for three. The article not abstracted treats the properties of powdered iron-brass compositions. (D.E.B.)

**18680** (FTD-TT-62-1473(p.12-24)) INVESTIGATION OF THE SHORT-PERIOD STRENGTH [OF] HEAT-RESISTANT CERMET MATERIALS. V. N. Rudenko. Translated from Poroshkovaya Met., Akad. Nauk Ukr. SSR, No. 4, 83-93(1961).

Experiments show that the strength of hardened silicon carbide increases with an increase of temperature to 1200°C both in the presence of stress and bending, and the bend strength is 2.5 times greater than the longitudinal strength. The strength of material on a base of silicon carbide and chromium carbide varies insignificantly with an increase in temperature up to 950°C. Hardened silicon carbide is not very sensitive to the concentration of stress, but material on a base of chromium carbide exhibits more sensitivity to the concentration of stress. Electrochemical work of samples of hardened silicon carbide lead to a significant increase, up to 50%, in strength both at room and high temperatures. (H.G.G.)

**18681** (FTD-TT-62-1473(p.25-30)) ON THERMAL FATIGUE OF METAL-CERAMIC MATERIALS. G. N. Tret'yachenko, et al. Translated from Poroshkovaya Met., Akad. Nauk Ukr. SSR, No. 4, 94-7(1961).

The magnitude of the thermal-stability criterion for cermet materials decreases by a factor of 3-4 after several tens of cycles. Cermet components operating under conditions of thermal fatigue are ruptured generally without developing preliminary cracks. However, if the cermet components operate at the thermal-fatigue limit, they may exhibit cracks extending down to a certain depth, which remains unchanged for a long time. Silicon carbide compositions were the most thermally stable of all compositions tested. (H.G.G.)

**18682** (FTD-TT-62-1473(p.31-7)) PURIFICATION OF MOLTEN SODIUM BY CERMET FILTERS. I. M. Fedorchenko, et al. Translated from Poroshkovaya Met., Akad. Nauk Ukr. SSR, No. 4, 98-102(1961).

The use of cermet filters affects an improvement in the degree of purification of liquid sodium, and their use permits the development of a convenient and reliable apparatus for this filtration process. Tubular filters of iron, nickel, and titanium permits many advantageous uses as filtering elements. The use of iron, nickel, and stainless steel powder for filtering elements allows the use of welding when installing filters, and simplifies their manufacture and increases operational reliability. (H.G.G.)

**18683** ARC SKULL MELTING AND CASTING OF URANIUM CARBIDE. J. Crane, F. B. Litton, and H. S. Kalish (United Nuclear Corp., New Haven). Am. Soc. Metals, Trans. Quart., 56: 176-93(Mar. 1963).

A method for preparing high-density, massive uranium carbide in the form of solid cylinders $^{7}/_{16}$ to 1-in. dia and 6 in. long by skull arc melting and casting with nonconsumable electrodes is described. The procedure permits good control over melting parameters and yields a product low in nitrogen and oxygen (less than 100 and 300 ppm, respectively) and homogeneous to within 0.05 wt % C. Control of skull and charge composition are essential to accommodate carbon pick-up by the melt from the graphite electrode. Utilizing these controls, castings can be made to ±0.1 wt % of the desired carbon content. Low-density uranium carbide, containing free carbon and oxygen, prepared by reaction of $UO_2$–graphite compacts, appears to be the most suitable feed material for the process. Preliminary tests indicate consumable uranium carbide electrodes can be made using compacted $UO_2$–graphite material reacted to form uranium carbide. (auth)

**18684** THE TECHNOLOGY OF SUPERCONDUCTORS WITH EXTREMELY HIGH CRITICAL FIELD STRENGTHS. E. Saur (Universität, Giessen, Ger.). Ber. Oberhess. Ges. Natur- Heilk. Giessen, Naturw. Abt. (N.F.), 31: 159-61 (1961). (In German)

Studies on the preparation of rings and coils from Nb–Sn alloys are reported. The processes considered are compression, sintering, diffusion, and vapor deposition. (J.S.R.)

**18685** PURIFICATION OF ZIRCONIUM BY FUSION IN ELECTRON BEAM FURNACE. Philippe Albert, Louis Renucci, and Pierre Lehr (CNRS, Vitry-sur-Seine, France). Bull. Soc. Chim. France, No. 11-12, 2091-6(Nov.-Dec. 1962), (In French)

The first results obtained on the elimination, by fusion in an electron beam furnace under high vacuum, of metallic and metalloid impurities of Zr are reported. The experiments were made on "Kroll" and high purity "Van Arkel" zirconium. Direct fusion in the electron furnace of the "Kroll sponge" yields a metal with much higher purity than that of the metal obtained by arc fusion of the same sponge. The elimination of oxygen and nitrogen by electron beam fusion was studied in detail because of the importance of these elements in zirconium metallurgy. This procedure permits massive elimination of the oxygen and nitrogen as is shown by the determinations and physical measurements such as hardness and low-temperature electric resistivity. (tr-auth)

**18686** ZIRCONIUM ALLOYS FOR PRESSURIZED WATER REACTORS. Engineer, 214: 588-9(Oct. 5, 1962).

A summary of the discussion on zirconium alloys at the Institute of Metals meeting in Swansea on September 26, 1962 is presented. The development of zirconium alloys for use as fuel cans, pressure tubes in pressurized water, and structural components is reviewed. Corrosive effects of carbon dioxide and superheated steam on zirconium alloys are discussed. Factors influencing mechanical properties are also considered. (M.C.G.)

**18687** DEVELOPMENT OF URANIUM METAL PRODUCTION IN AMERICA. H. A. Wilhelm (Ames Lab., Ames, Iowa). J. Chem. Educ., 37: 56-68(Feb. 1960). (ISC-1076)

The discovery and first preparations of uranium are described. The development of production methods is outlined. Topics covered include: uranium production prior to the atomic age, expansion of uranium metal operations in 1942, developments in casting and preparation in 1942, expansion of the calcium-$UF_4$ process, methods development, and industrialization of processes. (M.C.G.)

**18688** CERTAIN DATA ON URANIUM MINERALS OF ONE OF THE PEGMATITE DEPOSITS. L. F. Syritso. Vestn. Leningr. Univ., No. 24, Ser. Geol. i Geogr., No. 4, 65-73(1962). (In Russian)

Some data on the secondary uranium minerals which are formed while substituting the primary uranium mineral, uraninite are given. Among the secondary minerals clarkeite, thorium curite, and uranophane were found. Otenite was formed while substituting apatite. (auth)

**18689** CONSTITUTION DIAGRAMS. R. R. Freeman and M. G. Manzone. Molybdenum Metal Technical Notes, Dec. 1961. New York, Climax Molybdenum Co., 1961. 19p.

Selected references on known binary and more complex constitution diagrams involving molybdenum are presented. Over 150 alloys and systems are included. (M.C.G.)

**18690** METHOD FOR PREPARING ALKALI METAL BORANES FROM BORON HALIDE AND ALKALI METAL HYDRIDE. F. Schubert and K. Lang (to Farbenfabriken Bayer Aktienges). German Patent DAS 1,143,188. Feb. 7, 1963. Filed Nov. 12, 1959.

A method is described for preparing alkali metal boranes from boron halide or its addition compounds with the help of alkali metal hydride or alkali metal and hydrogen, especially in the presence of a tertiary amine. It is proposed to use alkyl boric acid diamides or dialkyl boric acid amides as boron amide catalyzer. (Gmelin Institute)

**18691** PURIFICATION OF BERYLLIUM. Bernard Love (to Nuclear Corp. of America). U. S. Patent 3,083,094. Mar. 26, 1963. Filed June 30, 1959.

A simple method is given for purifying Be. The method comprises melting the Be with a rare earth metal, e.g., ytterbium, cooling the mixture, and separating the purified Be from the upper portion of the melt. The amount of rare earth metal should be sufficient to react with the impurities in Be and may be 2 to 5 wt %. (D.L.C.)

**18692** EXTRACTION OF THORIUM FROM THORIUM CHLORIDE AND PRODUCTION OF MAGNESIUM–THORIUM ALLOYS. Frank Pitts (to Magnesium Elektron Ltd.). U. S. Patent 3,084,040. Apr. 2, 1963. Priority date Apr. 28, 1958, Great Britain.

A process is outlined for producing a Mg–Th hardener alloy. The process comprises forming a fused mixture of Th chloride and an alkali metal or alkaline-earth metal chloride, treating the fused mixture with an excess of Mg, and separating the resulting Mg–Th alloy from the melt. $CaF_2$ may be added to the separated alloy to convert the residual chlorides to a dense solid mass. (D.L.C.)

**18693** ALLOY FOR FUEL OF NEUTRONIC REACTORS. Clarence H. Bloomster and Yoichi B. Katayama (to U. S. Atomic Energy Commission). U. S. Patent 3,086,930. Apr. 23, 1963.

This patent deals with an aluminum alloy suitable as nuclear fuel and consisting mainly of from 1 to 10 wt % of plutonium, from 2 to 3.5 wt % of nickel, the balance being aluminum. The alloy may also contain from 0.9 to 1.1 wt % of silicon and up to 0.7% of iron. (AEC)

**18694** PREPARATION OF SPHERICAL URANIUM DIOXIDE PARTICLES. R. P. Levey, Jr. and A. E. Smith (to U. S. Atomic Energy Commission). U. S. Patent 3,087,781. Apr. 30, 1963.

This patent relates to the preparation of high-density, spherical $UO_2$ particles 80 to 150 microns in diameter.

Sinterable $UO_2$ powder is wetted with 3 to 5 weight per cent water and tumbled for at least 48 hours. The resulting spherical particles are then sintered. The sintered particles are useful in dispersion-type fuel elements for nuclear reactors. (AEC)

**18695** METHOD OF SINTERING URANIUM DIOXIDE. Courtland M. Henderson and J. A. Stavrolakis (to U. S. Atomic Energy Commission). U. S. Patent 3,087,876. Apr. 30, 1963.

This patent relates to a method of sintering uranium dioxide. Uranium dioxide bodies are heated to above 1200°C in hydrogen, sintered in steam, and then cooled in hydrogen. (AEC)

## Corrosion

**18696** (BMI-X-222) CORROSION OF HYDROFLUORINATOR LINES HFV-2207-1 AND Ms-1000-1. P. D. Miller, W. N. Stiegelmeyer, W. K. Boyd, and F. W. Fink (Battelle Memorial Inst., Columbus, Ohio). Apr. 1, 1963. Contract [W-7405-eng-92]. 8p.

Following runs R-1 through R-6 and run T-11, the hydrofluorinator FV-1000 was cut apart for examination. Results of metallographic examination of the HF inlet line and the salt-transfer line are discussed. The metallographic study showed that INOR-8 was resistant to the environment. The alloy was not leached selectively or attacked intergranularly. The surface roughening, or etching, was much greater in the HF line than in the salt-transfer line and the total metal loss was also greater in the gas line. The apparent corrosion rates, however, were greater in the salt-transfer line, possibly as a consequence of errors in values used for original dimensions. (J.R.D.)

**18697** (DPST-62-71-4) APPLICATION OF THE ELECTRON MICROPROBE TO THE STUDY OF ZIRCALOY CORROSION FILM. Quarterly Progress Report, October–December 1962. (Du Pont de Nemours (E. I.) & Co., Wilmington, Del.). Feb. 1963. Contract AT(07-2)-1. 14p.

An exploration of the possibilities of obtaining new information concerning the corrosion mechanisms of zirconium alloys, particularly Zircaloy-2, with the aid of the electron microprobe is discussed. Attempts were made to correlate the chemical constitution of the oxide film with that of the underlying alloy and to determine the role of the alloying elements in the oxidation process. The importance and efficiency of the electron probe microanalyzer for technological studies in metallurgy is demonstrated. (H.G.G.)

**18698** (JAERI-1035) CORROSION OF ALUMINUM IN WATER. M. Kawasaki, S. Nomura, H. Itami, Y. Kondo, T. Kondo, N. Ito, and C. Akutsu (Japan Atomic Energy Research Inst., Tokyo). June 1962. 44p.

Dynamic corrosion of aluminum was studied under conditions corresponding to those prevailing in reactors. When commercial grade pure aluminum is corroded in flowing water at 50 to 70°C, the weight of the aluminum specimen will increase with time at low flow rates, and decrease with increasing flow rate. The change of weight of the specimen is also affected by water purity and conditions of the surrounding atmosphere. The total amount of corrosion from chemical analysis does not always parallel the change of weight of the specimen, and pitting (about 10 microns in diameter) is also observed to occur in many specimens. It can therefore be concluded that it is difficult to estimate the corrosion amount only from the change of weight of the specimen. In several cases the relation between the properties of surface oxide film and corrosion reaction in flowing water was established. With the further objective of developing aluminum alloys that are corrosion-resistant in hot water, some studies on the corrosion mechanism of aluminum alloys in hot water and steam were conducted. In hot water, aluminum is corroded easily with higher purities of the metal, and according to Draley, this is due to the penetration of hydrogen into the grain boundaries. Various methods were used to ascertain his mechanism, and in particular, hydrogen evolution at the grain boundaries was directly observed in a windowed autoclave. It was also established by x-ray and electron-microscopic methods that the transformation and structural change of the surface oxide film modifies the kinetics of corrosion of aluminum in steam around 350°C. (auth)

**18699** (NP-12648) CAVITATION AND EROSION DAMAGE MEASUREMENTS WITH RADIOISOTOPES (SUMMARY OF INTERNAL REPORT NO. 4). Internal Report No. 8. William J. Walsh and Frederick G. Hammitt (Michigan. Univ., Ann Arbor. Research Inst.). Aug. 1, 1961. 23p.

A radiotracer technique has been developed for the continuous measurement of cavitation damage in a closed-loop venturi facility and used to determine the damage rate of type 302 stainless steel in a cavitation field as a function of time. The size of particles removed from the test specimens was measured using a radiotracer sieving method. It is believed that these techniques have broad application in the field of cavitation and erosion studies. The measurements obtained are unique in providing an accurate damage rate measurement as a function of time for the initial stages of damage, as well as yielding an indication of particle size. The wear rates measured ranged from 0.15 mg/hr to 0.001 mg/hr and the particle sizes were predominantly between 0.5 and 3 mils. (auth)

**18700** (TID-18420) KINETICS OF OXIDATION OF IRON–CHROMIUM ALLOYS AND THE TRANSPORT PROPERTIES OF THE OXIDES IN CARBON DIOXIDE–CARBON MONOXIDE MIXTURES. End of Year Report. Roger L. Levin and J. Bruce Wagner, Jr. (Northwestern Univ., Evanston, Ill.). Jan. 31, 1963. Contract AT(11-1)-1126. 207p.

The oxidation of iron–chromium alloys containing 0.20, 0.88, 1.70, 5.70, 7.55, and 18.21 wt % Cr was studied in $CO_2$–CO mixtures over the temperature range 800 to 1100°C under conditions where wüstite is the only stable iron oxide. The experimental results, obtained from a continuous recording of the gain in weight by a semi-micro automatic recording balance, show that all of the alloys oxidize in $CO_2$–CO mixtures with the same sequence of mechanisms. The first stage of the reaction is one of linear oxidation where the rate-controlling process is a phase-boundary reaction at the wüstite/gas interface which is determined to be the adsorption of $CO_2$ below about 950°C and the dissociation of $CO_2$ into CO and adsorbed oxygen atoms or ions above this temperature. The second stage of the reaction is one of parabolic oxidation kinetics where diffusion of the metal ions and electrons through the scale is the rate-determining step. The oxide thickness at which the kinetics transform from linear to parabolic is dependent upon chromium content in the wüstite and upon temperature. The effect of soluble chromium in the wüstite lattice is to cause an increase in the cation vacancy concentration which is manifested as an increase in the rate of parabolic oxidation of the Fe–Cr

alloys over that of pure iron oxidized under the same conditions. The rate of oxidation of Fe–Cr alloys is shown also to be many times more rapid in $CO_2$–CO mixtures than in oxygen. (auth)

**18701** (AEC-tr-5724) CAUSES OF STRESS CORROSION SUSCEPTIBILITY IN NONFERROUS ALLOYS AND STEEL. Ludwig Graf. Translated by L. P. Costas (Savannah River Lab., Aiken, S. C.) from Werkstoffe Korrosion, 9: 693-8(Nov. 1958). 10p.

The localization of stress corrosion in homogenous solid solutions is caused by an effect which consists of an increase in grain boundary reactivity due to solid solution formation. The intensity of this effect depends on the concentration and is greatest at 50 at. %. This increase of reactivity in the grain boundaries occurs only by the action of chemical agents when an electrochemical process occurs which is effected during the dissolution of homogenous solid solutions by the less noble sites. Regarding the role of tensile stress on stress corrosion, another solid solution effect was demonstrated. This consisted of a further increase in reactivity at the base of the notch in inter- or trans-granular cracking immediately during a plastic deformation. Crack formation starts first and then flow begins at the base of notches which formed due to localized attack at the grain boundaries or slip lines. The stress corrosion susceptibility of brass in ammonia and of purest iron are special cases, and explanations are given. (H.G.G.)

**18702** (CEA-tr-R-1639) CORROSION DES MATÉRIAUX POUR RÉACTEURS. II. FACTEURS PRINCIPAUX DE LA CORROSION D'UN METAL SOUS CONTRAINTE. (Corrosion of Reactor Materials. II. Principal Factors in Corrosion of a Metal Under Stress). P. A. Akol'zin and V. N. Gulyaev (Guliaev). Translated into French from Korroziya Reaktornykh Materialov, Sb. Statei, 69-77(1960). 18p.

The principal factors in the corrosion of stainless steel under stress are reviewed and discussed in some detail, with a consideration of the effect of the presence of passivators, depassivators, and depolarizers in the aqueous media. The action of aqueous media containing oxygen, chlorides, free alkali, and other corrosive agents is described. The characteristics and mechanisms of the corrosion process vary for the different corrosive agents. (J.S.R.)

**18703** (NP-tr-970) ON THE MORPHOLOGICAL DEVELOPMENT OF OXIDATION (BY AIR AND BY $CO_2$) OF PYROLYTIC GRAPHITE. François-Michel Lang, Pierre Magnier, Claude Sella, and Jean-Jacques Trillat. Translated by J. Roberts (U.K.A.E.A. Atomic Energy Research Establishment, Harwell, Berks, Eng.) from Compt. Rend., 254: 4114-16(June 13, 1962). 10p. (Handwritten MS).

Corrosion in air at 600°C or in carbon dioxide at 800°C (the gases being purified and dried), of pyrolytic graphite previously treated above 3000°C appears to progress more rapidly on the edges than on the base planes. However, the specific rates of oxidation are the same as those obtained for numerous purified carbons of very diverse origins. The apparent difference of rate is due to the more pronounced roughness of the edges. Observation by electron microscope shows that oxidation occurs on the whole surface of the graphite, originating at the numerous crystalline distortions which appear to be distributed at an average distance of the order of a micron. (auth)

**18704** CORROSION OF REFRACTORY METALS BY LIQUID TIN. J. R. Lance and G. A. Kemeny (Westinghouse Electric Corp., Pittsburgh). Am. Soc. Metals, Trans. Quart., 56: 204-5(Mar. 1963).

The corrosive effects of liquid tin on Mo, Ta, Nb, and W were studied. The results showed that all of the refractory metals tested were attacked by liquid tin at 800°C. Mo and Ta were also attacked at 630°C, but Nb showed no visible corrosion at this temperature. W was not tested at the lower temperature. (P.C.H.)

**18705** THE OXIDATION CHARACTERISTICS OF NIOBIUM-1 ZIRCONIUM ALLOY. E. J. Delgrosso, R. C. Krutenat, C. E. Carlson, and J. S. Carta (Pratt and Whitney Aircraft, United Aircraft Corp., Middletown, Conn.). J. Less-Common Metals, 5: 57-77(Feb. 1963). (In English)

The oxidation of Nb-1 Zr alloy was investigated by continuous weight gain measurements in the temperature range from 400 to 2200°F. The majority of these tests were conducted in flowing, dry air, although several tests were made in argon atmospheres contaminated with room air at levels of one and 5% oxygen (10,000 and 50,000 ppm). Oxidation rates, kinetic relationships, total oxygen contamination values, and temperature coefficients of the linear oxidation rates are presented in tabulated and graphical form. The effects of specimen geometry and physical condition of the alloy were examined by testing specimens of various shapes in the cast, cold reduced, and recrystallized conditions. The results obtained in this investigation are compared with previous work on pure niobium. (auth)

**18706** STUDIES OF THE CORROSION OF ALUMINIUM AND ITS ALLOYS FOR NUCLEAR REACTOR. I. CORROSION BEHAVIOR OF ALUMINIUM IN HIGH PURITY WATER UP TO THE TEMPERATURE OF 100°C. Goro Ito, Yoshihiko Shimizu, and Fumio Sawayanagi. Trans. Natl. Res. Inst. Metals (Tokyo), 4: 36-47(1962). (In English)

Studies were made of the corrosion characteristics of aluminium in high-purity water up to the temperature of 100°C, and included studies of corrosion products, the effect of dissolved oxygen on corrosion, and the use of inhibitors to suppress corrosion. The corrosion product film on aluminium in high-purity water at the temperature of up to 85°C was identified as Bayerite, and it converts to Boehmite at higher than 90°C. The additives to high-purity water which showed the inhibitive action were sulfate, silicate, chromate, dichromate, phosphate, and arsenite. Dissolved oxygen in high-purity water up to 100°C, retarded corrosion. And this effect can explain the results of experiments about the effect of specific volume of testing water to the area of aluminium specimen exposed and of the crevice corrosion test. (auth)

**18707** STUDIES OF THE CORROSION OF ALUMINIUM AND ITS ALLOYS FOR NUCLEAR REACTOR. II. ALUMINIUM ALLOYS RESISTANT TO WATER AT HIGH TEMPERATURE UP TO 300°C. Goro Ito, Yoshihiko Shimizu, and Fumio Sawayanagi. Trans. Natl. Res. Inst. Metals (Tokyo), 4: 48-52(1962). (In English)

For application of aluminum alloys to the power reactor, it would be desirable for them to have properties of high mechanical strength together with good corrosion resistance at reactor operating temperature. Preliminary work conducted to survey the effect of various alloying elements on corrosion resistance in high-purity water and on the mechanical strength of alloys at the temperature of 300°C is reported. The alloying elements which proved to improve corrosion resistance of aluminium were iron, nickel, copper, silicon, palladium, and titanium, and which proved to increase strength at high temperature were copper, silicon, and magnesium. It was concluded from these results

that the alloy C-18 (1.2 Fe-1.4 Cu-1.2 Ni-1.1 Mg-Al) was the best alloy tested. (auth)

**18708** CORROSION RESISTANCE OF MOLYBDENUM AND MOLYBDENUM-BASE ALLOYS. R. R. Freeman and J. Z. Biggs. Molybdenum Metal Technical Notes, Nov. 1959. New York, Climax Molybdenum Co., 1959. 24p.

Data on the corrosion of Mo and Mo-base alloys in acids, gases, liquid metals, and other media are presented in tabular form. Effects of manufacturing process, composition, and conditions are discussed. (M.C.G.)

## Fabrication

**18709** (AD-299181) DEVELOPING TECHNOLOGY TO FORGE UNCLAD BERYLLIUM. PHASE II, DECEMBER 1, 1962-FEBRUARY 28, 1963. TR-304-237. M. B. Hornak and R. G. O'Rouke (Brush Beryllium Co., Cleveland). 8p.

Work which was completed during the period (Dec. 1962 through Feb. 1963) on the program to develop the required technology to successfully forge beryllium aircraft and missile shapes using unclad beryllium preforms and billets is discussed. (H.G.G.)

**18710** (BRB-70) PROCESS DEVELOPMENT SUMMARY, JANUARY-JUNE 1962. (Bridgeport Brass Co., Seymour, Conn.). Jan. 25, 1963. Contract AT(30-1)-1405. 64p.

Experimental results on Mark V-B extruded reactor grade U tubing led to the conclusion that the amount of finished stock can be reduced thus reducing machining costs and amount of scrap recycle. In evaluation of upset forging, results of work indicate that although this method is feasible, the production Mark V-B tubular slugs are too variable to warrant further investigation. Initiation of a large-scale lubrication study to find commercial lubricants with exhibit acceptable as-coated properties in various heating media at 200 to 1200°F is reported. Preliminary data on a number of lubricants are included. A program was also initiated to develop extrusion piercing as a satisfactory method for producing hollow ingots. Two methods of piercing were found to warrant further investigation. (J.R.D.)

**18711** (DP-493) SWAGING OF URANIUM DIOXIDE TUBES. [PART] I. Anthony S. Ferrara (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). Aug. 1960. Contract AT(07-2)-1. 24p.

A method was developed for fabricating tubular fuel elements of uranium dioxide by swage compaction of crushed, fused $UO_2$. The elements were 5 to 10 ft long and were clad with stainless steel. $UO_2$ densities up to 91% of theoretical were obtained in tubes about 2.1 in. outside dia and 0.3 in. wall thickness. (auth)

**18712** (GEAP-3918) FABRICATION OF FUEL ELEMENTS BY SWAGING. E. A. Lees (General Electric Co. Vallecitos Atomic Lab., San Jose, Calif.). May 21, 1962. Contract AT(04-3)-361. 80p.

Potential low-cost fuel-element fabrication concepts were investigated to establish process parameters and to fabricate test specimens for VBWR irradiations. The concepts investigated were swaging over pellets, powder compaction by swaging, and powder compaction by hot swaging. Stainless steel cladding was used throughout the program with a reference wall thickness of 10 mils. A process for swaging over as-sintered pellets was developed using nylon dies. Pellet diameters varied as much as 10 mils with little or no breakage. Limitations of nylon die swaging were investigated and were found to be a function of tube diameter-to-wall thickness ratio and tube yield strength. A process for swaging 10-mil clad fused $UO_2$ filled rods to a density of 93 ±1% was established. Spencer-fused $UO_2$ was the feed material loaded to an initial density of 70% theoretical. The rods were reduced from 0.5 inch diameter to 0.4 inch diameter. A second process investigated consisted of loading a $^{7}/_{16}$ inch OD tube to 86% of theoretical by vibratory compacting followed by a one-pass swage to 0.4 inch final diameter. Collapsible end plugs were used in the fuel rods as an economy measure to eliminate machining operations after swaging. Hot swaging was investigated and fuel rods clad in 10-mil stainless steel were fabricated to densities as high as 95.2% TD. Ten fuel rods clad in 16-mil type 304 ELC stainless steel tubing were fabricated for and are being irradiated in VBWR. (auth)

**18713** (GEAP-4115) FABRICATION OF ZIRCONIUM ALLOYS FOR SPECIFIC ZIRCONIUM ALLOY DESIGN PROGRAM. K. C. Antony and L. T. Jones (General Electric Co. Vallecitos Atomic Lab., San Jose, Calif.). Dec. 5, 1962. Work performed under United States-Euratom Joint Research and Development Program. Contract AT(04-3)-189. 36p. (EURAEC-577)

The raw materials and fabrication procedures employed in preparing thirty-two Zr alloy compositions for evaluation as described in GEAP-3979 are reported. Fabricability was evaluated in terms of operator experience and compared with design specifications. The fabricability of beta-quenched Zr alloys (within the alloy field studied) correlated well with annealed total elongation measured in a simple room temperature tensile test. Detailed chemical analysis and selected autoclave tests indicate homogeneous alloys with low interstitial contents were attained using the procedures described. Considerations involved in the extension of reported laboratory procedures to larger scale production are discussed. (auth)

**18714** (LA-2751) ELEVATED TEMPERATURE DIFFUSION BONDING OF TUNGSTEN TO TUNGSTEN UNDER PRESSURE. R. I. Batista, G. S. Hanks, and D. J. Murphy (Los Alamos Scientific Lab., N. Mex.). Aug. 1962. Contract W-7405-eng-36. 54p.

Solid-state diffusion bonding of tungsten to tungsten was investigated at temperatures ranging from 1700 to 2600°C, under surface contact pressures up to 3000 psi, while under high vacuum or hydrogen atmosphere. Various interface coatings were employed to promote diffusion, including graphite, oxide, metal slurries, electroplates, direct surface oxidation, and Mo-W deposits from carbonyl decompositions. Thorough metallurgical bonding was achieved, particularly with the latter two surface coatings, after 2 hours at 2350°C in $H_2$ under 1400 psi. Corresponding tensile strengths of 30,000 psi were obtained. Powder-compacted tungsten sheet containing 50 vol % $UO_2$, spray-coated with an outer layer of tungsten, was effectively bonded to itself and to tungsten metal under 2 hour diffusion treatments at 2000°C and moderate pressures of the order of 1000 psi. (auth)

**18715** (LADC-5262) ELEVATED TEMPERATURE DIFFUSION BONDING OF TUNGSTEN TO TUNGSTEN UNDER PRESSURE. R. I. Batista, G. S. Hanks, and D. J. Murphy (Los Alamos Scientific Lab., N. Mex.). [1962]. Contract [W-7405-eng-36]. 33p.

Solid state diffusion bonding of tungsten to tungsten was investigated at temperatures ranging from 1700 to 2600°C, under surface contact pressures up to 3000 psi, while under high vacuum or hydrogen atmosphere. Various inter-

face coatings were employed to promote diffusion, including graphite, oxide, and metal slurries, electro-plates, direct surface oxidation, and Mo–W deposits from carbonyl decompositions. Thorough metallurgical bonding was achieved, particularly with the latter two surface coatings, after 2 hours at 2350°C in $H_2$ under 1400 psi. Corresponding tensile strengths of 30000 psi were obtained. (auth)

**18716** (NAA-SR-7973) DEVELOPMENT OF NIOBIUM DIFFUSION BARRIERS FOR ALUMINUM-CLAD URANIUM ALLOY FUEL ELEMENTS. B. N. Briggs and W. H. Friske (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). [nd]. Contract AT (11-1)-Gen-8. 50p.

Nickel was used as a diffusion barrier for Al-clad uranium alloy fuel elements, operating at 650°F in organic-cooled reactors. Advanced organic-moderated reactor (AOMR) concepts include operating temperatures up to 850°F. Since the interdiffusion of Al–Ni is 150 times faster at 850°F than at 650°F, an alternate diffusion barrier is required. Subsequent studies resulted in the selection of niobium. Several techniques for bonding niobium to the U–10 Mo fuel were investigated. After considerable development effort, electron beam vacuum deposition yielded adherent, nonporous, ductile coatings. Isostatic bonding, at 1050°C and 12,000 psi for 1 hr, also resulted in metallurgically bonded niobium on the major surfaces of U–10 Mo fuel plates. Roll-bonding achieved metallurgically bonded plates on small test specimens, but was never reproduced on full-size plates. Vapor phase deposition, by $H_2$ reduction of $NbCl_5$, was also partially successful, but not reproducible. Ultrasonic bonding has shown promise in spot welding tests. Plasma-spray coating and electroplating in a fused salt bath were also considered, but not actively evaluated. (auth)

**18717** (TID-7624) ATOMIC ENERGY COMMISSION WELDING FORUM, 1959 ANNUAL MEETING, HELD IN CHICAGO, ILLINOIS, OCTOBER 13-14, 1959. (Division of Reactor Development, AEC). 295p.

The verbal presentation that accompanied slides shown at the Forum is included. The slides are not reproduced. (D.E.B.)

**18718** (TID-18286) MATERIALS FOR HIGH TEMPERATURE NUCLEAR ENGINEERING APPLICATIONS. Quarterly Report No. 3, October 1, 1962 to January 1, 1963. J. D. Fleming, J. W. Johnson, Paul Boland, and S. H. Bomar (Georgia Inst. of Tech., Atlanta. Engineering Experiment Station). Contract AT(40-1)-2483. 40p.

A statistical study was made to determine the effects of the time allowed for thermal equilibration in the high-temperature ring tensile test of slip-cast fused silica. The study consisted of three firings; the rings from each firing being broken at 2000°F after soaking times ranging from 3 to about 25 min. The statistical analysis of the breaking loads showed variations between firings at greater than the 99% confidence level. Variations between soaking times failed to show significance at the 95% confidence level. No evidence was detected of an interaction between the two factors. Studies of the Al–$U_3O_8$ reactions in a rolled plate of ATR composition containing 33.79 wt % $U_3O_8$, 66.07 wt % X-800 Al and 0.14 wt % $B_4C$ were initiated. Plate ATR specimens were subjected to x-ray diffraction in the as-received condition, after being heated to 1000, 1200, 1400, 1600, and 1830°F, and after vacuum annealing. Both Al and $U_3O_8$ showed consistent diffraction decreases with increasing severity of heating. Metallographic examination of the ATR specimens indicated formation of a reaction zone, probably principally $Al_2O_3$, around the $U_3O_8$ which were converted to a fragmented structure. Studies were also initiated to compare the reactions in cold pressed Al–$UO_2$ pellets with those in cold pressed Al–$U_3O_8$ pellets. (J.R.D.)

**18719** (TID-18324) THE COMPARISON OF SINTERING LOOSE METAL POWDERS AND PRESSED METAL POWDER COMPACTS. Progress Report, March 1, 1962–February 28, 1963. Fritz V. Lenel (Rensselaer Polytechnic Inst., Troy, N. Y.). Mar. 1963. Contract AT (30-1)-2408. 7p.

In sintering powder aggregates and compacts, externally applied forces play a large role in addition to the action of surface tension forces. The mass transport mechanism for sintering was shown to be due to dislocation motion rather than to diffusional processes. In order to differentiate between dislocation motion and volume diffusion as the mass transport mechanism during the sintering of copper powder compacts at high temperature, their isothermal rate of shrinkage was measured in a dilotometer. Results indicate that even at temperature in the range 50 to 100°C below the melting point of copper, the mass transport mechanism for sintering of copper powder compacts is dislocation motion and not volume diffusion. (H.G.G.)

**18720** (EURAEC-470) ELECTROSLAG WELDING OF REACTOR STEELS. Quarterly Technical Report No. 5, July 1, 1962–September 30, 1962. (Schweisstechnische Lehr- und Versuchanstalt, Duisburg, Germany). Oct. 25, 1962. Work Performed under United States–Euratom Joint Research and Development Program. Contract 046-61-3RDA. 12p. A translation.

Smelting experiments were conducted in a water-cooled copper mold with welding rods with low P and S content in combination with welding powder containing little P and S. The welding work was carried out with alternating and direct current, with electrodes at the positive and negative poles in the latter case. These experiments were conducted to determine the effects produced on the P, S, and $N_2$ content of the welded material and the effects on its impact strength, particularly fatigue impact strength. Soviet literature on electroslag welding was examined, and a bibliography of this material from 1956-1962 is presented. (H.G.G.)

**18721** (FTD-TT-62-1789) FORGING MOLYBDENUM AND ALLOYS ON ITS BASE. T. V. Vorontsova and N. N. Morgunova. Translated from Kuznechno-Shtampovochnoe Proizv., No. 8, 8-11(1962). 11p.

In order to determine experimentally the plasticity of cast molybdenum alloys, experiments were conducted to determine the critical breaking reduction $\epsilon_{max}$ at various temperatures. Small cylinders with 20-mm diameter and 30-mm height were turned on lathe from ingots of molybdenum or its alloys. Upsetting was performed on hammer with 500-kg weight of drop parts per one blow. The upsetting test was conducted on test pieces cut from ingots of Mo, Mo–Ti–Zr alloys, and Mo–W alloys. The occurrence of a pattern of uneven upsetting, causing non-uniformities of deformation over the test piece cross section was established in examining the macro- and microstructure of upset test pieces. Cast Mo–W alloys, and then Mo–Ti–Zr alloys had the lowest plasticity up to 1300 to 1400°C. The alloy with small additives of Ti and Zr had the highest plasticity up to 1300 to 1400°C. At the same time its plasticity increased strongly in the deformed state. (M.C.G.)

**18722** FABRICATION OF FUEL ELEMENTS FOR THE GRAPHITE–CARBON DIOXIDE SYSTEM. J. Nadal. Energie Nucl., 4: 589-99(Dec. 1962). (In French)

The composition of fuel elements for reactors using uranium as fuel and graphite as moderator is briefly indicated. The technical problems in the fabrication of these fuel elements and the solutions in the various manufacturing stages—vacuum fusion and casting of uranium, preparation of rods, cans, and plugs, canning, and control—are described. The fabrication is characterized essentially by the importance of quality controls, the necessity of observing rigorous cleanliness (to prevent product contamination and assure personnel protection), and mass processing. (tr-auth)

**18723** FUEL ELEMENTS—MANUFACTURING PROCEDURE. J. Doumerc (Compagnie pour l'Etude et la Realisation de Combustibles Atomiques, Paris). Energie Nucl., 5: 4-15(Jan.-Feb. 1963). (In French)

In a nuclear reactor, the problem of the heat transfer from the fuel to the cooler is complicated by the presence of the can, and especially by the surface of separation between the can and the fissile material. The realization of a fuel element resulting from the combination of the fuel and the can has instigated many researches, from which a great number of manufacturing methods have been developed. A review is given of the processes of forming the combustible elements, which are classed in two groups: 1) Independent shaping of two components followed by an assembling (free or semi-free can, mechanical or metallurgical bond). 2) Co-shaping (with mechanical or metallurgical bond). (auth)

**18724** QUANTITATIVE METALLOGRAPHY WITH A DIGITAL COMPUTER: APPLICATION TO A Nb–Sn SUPERCONDUCTING WIRE. G. A. Moore and L. L. Wymann. J. Res. Natl. Bur. Std., 67A: 127-47(Mar.-Apr. 1963).

Accurate quantitative data pertinent to the structure of solid materials at the micro size level, which are difficult or prohibitive to obtain by traditional manual measurements, are now obtained directly by a digital computer which uses a photomicrograph as the information input. The history of picture interpretation experiments at the National Bureau of Standards is reviewed. The fundamental computer operations are illustrated, together with a description of 24-image processing routines now functional at a practical level. A micrograph of a specimen of Nb–Sn superconductor wire is exhaustively analyzed. This specimen is found to contain approximately 70 percent $Nb_3Sn$, nearly all of which is mutually interconnected. It is also found that in this specimen the mean free path in the $Nb_3Sn$ superconducting phase is only 26.5 microns. This small value results from the spongy structure of the material and numerous interruptions caused by voids and by particles of four other solid phases. The comparative importance of the several types of interruptions is measured. It is determined that small voids are the most important single cause of the short mean free path, and deduced that these voids appear to have formed mainly from the reaction during heat treatment. (auth)

**18725** MANUFACTURE OF NUCLEAR SHIELDS. Metal Ind. (London), 101: 193-4(Oct. 25, 1962).

One of the applications for lead that has developed in recent years is for shielding in nuclear reactors, in isotope containers, and in instruments using gamma and beta ray, as well as x ray, sources. Some of the methods of manufacture for lead components in this type of shielding are described. (auth)

**18726** AN APPROACH TO VIBRATION COMPACTION OF URANIUM DIOXIDE. Shuichiro Takahashi and Naoto Asami (Mitsubishi Atomic Power Industries, Inc., Japan). Nippon Genshiryoku Gakkaishi, 5: 133-40(Feb. 1963). (In Japanese)

Particle packing by mechanical vibration was experimentally studied with spherical metal shot and uranium dioxide powder particles for an idealized and actual cases, respectively. The effect of water content on efficiency of packing was studied. Particles of unitary, binary and ternary size components in a cylindrical glass container were packed by controlled sinusoidal vibration (10c to 10 kc). With metal shot, densities of 64.0, 86.1, and 92.4% of theoretical were attained from unitary, binary, and ternary components, respectively. With uranium dioxide maximum attained densities were 60.5, 78.9, and 85.0%, respectively. An economic mixing of two kinds of uranium dioxide, i.e., coarse fused particles (–3 ~ +10 mesh) and high fired (Mitsubishi Swageable–50 mesh) $UO_2$ showed a density of 83.5%, nearly as high as that attained in ternary packings mentioned above. By adding slight amount of water, packing density decreased abruptly and this effect was more remarkable with packings of finer particles. (auth)

**18727** SOLID STATE WELDING OF BERYLLIUM. E. M. Passmore (Manlabs, Inc., Cambridge, Mass.). Welding J. (N. Y.), 42: 186s-9s(Apr. 1963).

The welding of both hot-pressed and hot-pressed and extruded beryllium powder was investigated, using the differential thermal expansion between the beryllium specimens and a molybdenum clamp to hold the adjoining surfaces in contact while induction heating in vacuum. The most complete bonding was observed to result when intimate contact across the weld interface was achieved using metallographically polished adjoining surfaces. Weld tensile strength was found to be closely dependent on prior roughness of the adjoining surfaces, welding temperature, and base metal strength. When the adjoining surfaces were prepared by mechanical polishing, weld strength was found to increase with increasing welding temperatures up to the range 900 to 975°C. Above 975°C strength decreased because of grain growth in the base metals. The maximum strengths were equal to those of the base metals—about 40,000 psi for hot pressed and about 60,000 psi for extruded beryllium, respectively. The attainment of weld strengths equal to those of the base metals with little plastic deformation and no observable grain growth across the interface during welding indicates that the bonding mechanism involves the attainment of atomic contact across the interface. This contact is probably facilitated by the occurrence of some localized plastic deformation and surface diffusion. However, no direct evidence of these processes was observed. The rapid initial increases in weld strength with increasing welding temperature are attributed largely to the decreasing yield strength and increasing atomic mobility of the beryllium; this results in increasing contact area at the interface during welding. (auth)

**18728** WELDING. (SUPPLEMENT TO CTRs 324-331). OTS Selective Bibliography. (Office of Technical Services, Washington, D. C.). Jan. 1963. 35p. SB-402(Rev.). $0.10(OTS)

A bibliography of published literature, providing a general coverage of welding for the period 1957-1962, is presented. (H.G.G.)

**18729** ELECTROLYTICAL APPLICATION OF RADIOACTIVE COATINGS. Rudolf Bischof and Karel Papez. Czechoslovak Patent 99,982. Apr. 15, 1961.

A method for applying radioactive layers, in particular

$Sr^{90}$ and Ra, is described. Deposition of the elements is analogous to conventional electrolysis, but is performed from molten salts in organic solvents at high voltages. To obtain thicker coatings (determined by the weight of the deposited salt, and equal to tens of mg per 1 $mm^2$ of the cathode surface) and to maintain the current density at the required level (not below 10 mamp per 1 $cm^2$) it is suggested that the voltage be increased gradually from 100 v to 10 kv. To obtain a radiation source with a $Sr^{90}$ layer, strontium sulfocyanate is selected, and acetone is taken as a solvent. As a result, a layer of $Sr^{90}$ carbonate is deposited on the cathode. The radioactivity of one surface unit is a function of the initial salt concentration and initial voltage. It is noted that it is most convenient to obtain radioactive layers on radiation sources in the form of needles. Applications of the emitters produced by the method are given. (P.C.H.)

**18730** METHOD FOR PREPARING MASSIVE PROTECTIVE WALLS OF HIGH DENSITY. H. Van den Bergh, Hans-Dietrich Pardeicke, W. Troesch, and W. Janowsky. (to Leybold Hochvakuum-Anlagen GmbH). German Patent DAS 1,143,624. Feb. 14, 1963. Filed Dec. 1, 1960.

A method is given for preparing massive protective walls of high density, which comprises the steps of filling up the space between plankings with a material of high radiation protection properties and impregnating it afterwards with a fluid binding and packing agent. In order to achieve a high density and a wall which is free of cavities, the plankings form a vacuum-tight chamber. After filling up the chamber with the material of high radiation protection properties it is evacuated and the impregnating agent is sucked in to fill up the spaces within said material. Generally a vacuum of about 100 Torr proved to be satisfactory. (Gmelin Institute)

**18731** METHOD OF MAKING FUEL BODIES. Walter V. Goeddel and Mossaud T. Simnad (to U. S. Atomic Energy Commission). U. S. Patent 3,087,877. Apr. 30, 1963.

This patent relates to a method of making a fuel compact having a matrix of carbon or graphite which carries the carbides of fissile material. A nuclear fuel material selected from the group including uranium and thorium carbides, silicides, and oxides is first mixed both with sufficient finely divided carbon to constitute a matrix in the final product and with a diffusional bonding material selected from the class consisting of zirconium, niobium, molybdenum, titanium, nickel, chromium, and silicon. The mixture is then heated at a temperature of 1500 to 1800°C while maintaining it under a pressure of over about 2,000 pounds per square inch. Preferably, heating is accomplished by the electrical resistance of the compact itself. (AEC)

**18732** CONTROL ROD. David E. Walker and Steve Matras (to U. S. Atomic Energy Commission). U. S. Patent 3,087,879. Apr. 30, 1963.

This patent shows a method of making a fuel or control rod for a nuclear reactor. Fuel or control material is placed within a tube and plugs of porous metal wool are inserted at both ends. The metal wool is then compacted and the tube compressed around it as by swaging, thereby making the plugs liquid-impervious but gas-pervious. (AEC)

## Properties and Structure

**18733** (AD-278041L) ADVANCED EXPERIMENTS ON METAL–SILICON–BORON AND METAL–CARBON–BORON SYSTEMS. Final Technical Report. Hans Nowotny ([Vienna. Universität]). June 30, 1962. Contract 91-591-EUC-1810. 48p.

By means of x-ray techniques and metallographic methods the equilibria of high melting systems such as U–B–C, Th–B–C, Mo–B–C, Th–U–B, U–Ti–B, U–Zr–B, Ti–Al–Si, Zr–Al–Si, Hf–Al–Si, Cr–W–Si, and Mo–W–Si were investigated. Most of the newly detected phases interfering in these systems were determined. Data are included along with discussions of experimental methods and results. (J.R.D.)

**18734** (AD-282047) HIGH TEMPERATURE MATERIALS DEVELOPMENT. Progress Report, July 1962. (Raytheon Co. Research Div., Waltham, Mass.). Aug. 15, 1962. Contract NOrd 19135 (FBM). 13p. (S-453)

Further investigation was made to increase the thermal shock resistance of zirconium Pyrocarbide. Test bars of the Pyrocarbide with excess Pyrographite continue to show exceptional flexural strengths at room temperature to 1500°C. Since, at the compositions under study, the continuous phase is that of graphite, the thermal and elastic properties of this material are similar to graphite. Calculated thermal shock resistance shows a hundredfold improvement over the stoichiometric compound. Shock test bars of these coatings are being forwarded to the Atlantic Research Corporation for evaluation. (auth)

**18735** (AD-283585) DUCTILE CERAMICS RESEARCH. Final Report. E. R. Parker, J. A. Pask, and J. Washburn (California. Univ., Berkeley. Materials Research Lab.). Aug. 1962. Contract AF49(638)-601. 6p.

Work was confined to studies of cubic crystal ductility. Such material is highly ductile at room temperature when tested in single crystal form. Surface effects are extremely important and good ductility can be obtained only with specimens having carefully prepared chemically polished surfaces. It was found that MgO single crystals are ductile at room temperature and values of elongation in excess of 10% were obtained regularly. Alloying of ionic solids increased their strength. Recent work concerned grain boundary effects on the ductility of ionic solids; experiments indicated the smaller the grain size, the higher the strength, and the greater the probability of significant deformation before fracture. High purity is essential. Extrusion was chosen as a means of fabricating fine-grained LiF and slightly ductile specimens were obtained. (auth)

**18736** (AD-283667) THE ELECTRICAL BEHAVIOR OF REFRACTORY OXIDES. Quarterly Progress Report 203-8, April–June 1962. Robert W. Vest (Systems Research Labs., Inc., Dayton, Ohio). July 17, 1962. Contract AF33(616)-7748. 10p.

Charge transport by electrons and ions in $ZrO_2$, $ZrO_2$ + CaO, pure $Cr_2O_3$, and $Cr_2O_3$ + $Al_2O_3$ is being investigated using various experimental techniques. The development of special equipment was necessary to carry out measurements of electrical properties as a function of oxygen partial pressure. Apparatus and procedures include a furnace system, an electrical power system, an electrical measuring system, and a gas handling system calibration. (auth)

**18737** (AD-297058) DISLOCATIONS AND THE TENSILE STRENGTH OF POLYCRYSTALLINE MAGNESIUM OXIDE. Technical Report No. 18. R. J. Stokes and C. H. Li (Honeywell Research Center, Hopkins, Minn.). Jan. 1963. Contract Nonr-2456(00). 30p. (HR-63-252)

The tensile strength of polycrystalline magnesium oxide

can be high (approximately 30,000 psi) providing there are no fresh or mobile dislocations present. These dislocations may originate in one of two ways: directly by mechanical contact with the surface, and indirectly through the stress concentrations associated with pores. To attain tensile strengths higher than 10,000 to 15,000 psi, it is necessary to use fully dense pore free material whose surface was chemically polished or otherwise protected from mechanical contact. (auth)

**18738** (AFOSR-2645) THE STRUCTURE OF NbAs AND OF SIMILAR MONOPHOSPHIDES AND ARSENIDES OF NIOBIUM AND TANTALUM. Technical Status Report (Report No. 3), January 1, 1962–September 31, 1962. H. Boller and E. Parthé (Pennsylvania. Univ., Philadelphia. School of Metallurgical Engineering). Sept. 1962. Contract AF49(638)-1027. 15p. (AD-284060)

The structure of NbAs was solved and presents a new structure type, which is a transposition structure variation of the WC structure type. NbAs is tetragonal with a = 3.452 Å and c = 11.67(9) Å. Space group is C(11) sub 4V – I4(1) md with 4Nb in (4a) with z = 0 and 4As in (4a) with z = $^5/_{12}$. The same structure type was found to apply to TaAs with a = 3.437 Å and c = 11.65(6) Å and $\beta$-NbP with a = 3.334 Å and c = 11.37(8) Å. The previously reported structure proposal for $\alpha$ and $\beta$-NbP was proven to be wrong. In the case of a gradual P deficiency, a gradual structural change of the NbAs structure type was observed, which corresponds to a gradual irregular transposition, presenting a structure halfway between NbAs and WC. The new structure type and its variation fit well with the other known monophosphide or arsenide structure types. (auth)

**18739** (ANL-FGF-347) PREPARATION AND PROPERTIES OF URANIUM AND THORIUM MONOSULFIDES. P. D. Shalek (Argonne National Lab., Ill.). Apr. 30, 1962. Contract [W-31-109-eng-38]. 24p. (UAC-6504)

Uranium and thorium monosulfide bodies made by the reaction of $H_2S$ with the metal at low temperature followed by homogenization and sintering at high temperatures were found to have semi-metallic properties. The effect of homogenization and firing temperature, S/metal ratio, impurities, and atmosphere on the densification and properties of these bodies is discussed. Electrical resistivity, oxidation resistance, modulus of rupture, and other properties were evaluated and correlated with microstructure whenever possible. Some US–ThS solid solutions were made. (auth)

**18740** (BMI-X-226) MEASUREMENT OF THE COEFFICIENT OF FRICTION BETWEEN URANIUM AND STEEL AT HIGH ALPHA-URANIUM TEMPERATURES. E. S. Hodge, R. J. Carlson, E. G. Bodine, and E. G. Smith, Jr. (Battelle Memorial Inst., Columbus, Ohio). Apr. 9, 1963. Contract W-7405-eng-92. 15p.

Results of the tests to determine coefficient of friction data between uranium at 1050 to 1200°F and steel dies are presented. For the temperature range considered, the values for the coefficient of friction as calculated by the Amonton equation are relatively independent of temperature. The friction coefficient values were highest for the 450 BHN steel dies when considering only ground surfaces. Roughened die surfaces increase the values for the friction coefficient and die hardness appears to be less influential. The value of the coefficient of friction used in previous work for NLO, although not exact, was not unrealistic. These arbitrarily selected values were 0.25 and 0.33 in. (H.G.G.)

**18741** (CEA-2243) METHODE DE MESURE DYNAMIQUE DU MODULE D'YOUNG. APPLICATION AUX GRAPHITES NUCLEAIRES. (Dynamic Method for the Measurement of Young's Modulus. Application to Nuclear Graphites). F. Pattou and J. C. Trutt (France. Commissariat à l'Energie Atomique. Centre d'Etudes Nucléaires, Saclay). 1963. 27p.

A dynamic method has been developed for measuring Young's modulus and the rigidity modulus using the "Forster Elastomat." The principle consists in the determination of the resonance frequencies of graphite samples submitted to transverse, longitudinal, and torsional vibrations. The first two modes of vibration make it possible to calculate the elasticity modulus or the Young's modulus E, the third mode makes possible the calculation of the rigidity modulus G. The relationships from which the moduli E and G are measured are given. A systematic study has been made of graphite samples produced by extrusion or compression and submitted afterwards to one or several impregnations with pitch. For graphites made from the same coke by the same method, a linear relationship has been found for Young's modulus as a function of the apparent density. For the same apparent density, graphites made from different starting materials have generally different Young's moduli that bear a relationship to the crystalline characteristics of the material. The measurements of the rigidity modulus C made on different graphites also show the influence of crystallite orientation. (auth)

**18742** (DCAS-TDR-62-62) MATERIALS AND STRUCTURES—BERYLLIUM-CONTAINING MATERIALS PROGRAM. Semiannual Technical Report, July 1–December 31, 1961. E. G. Kendall and J. D. McClelland (Aerospace Corp., El Segundo, Calif.). Mar. 3, 1962. Contract AF04(647)-930. 15p.

Beryllium and its compounds are being studied to determine the degree to which they will be useful for future missile and space systems. To date, research has concentrated on optical properties of beryllia and the welding of beryllia to itself and other ceramics. The beryllide research studies were surveyed, and a research program is underway. A facility was designed for the handling of beryllium compounds and other toxic materials. (auth)

**18743** (EUR-132.f) CONTRIBUTION A L'ÉTUDE DU SYSTÈME NIOBIUM/ALUMINIUM. (Contribution to the Study of the Niobium–Aluminum System). M. J. Richards (European Atomic Energy Community and Brussels. Centre d'Étude de l'Énergie Nucléaire). 1963. Contract 023-61-7-ORGB. 13p.

Alloys covering the entire range of composition between pure Al and pure Nb were prepared by argon-arc melting using a non-consumable tungsten electrode. It was, however, not possible to prepare alloys containing a high percentage of Nb (over 40 at.%) directly from the two pure metals, and it was found necessary to start from Nb and a parent alloy containing about 47 wt % Al (corresponding roughly to the compound $NbAl_3$). This method made it possible to achieve a considerable reduction in the Al losses resulting from volatilization in the course of the melting process. The alloys were heat-treated in a tantalum resistance furnace up to 1800°C. This furnace makes it possible to quench the sample in vacuo in a liquid metal bath. The Al losses resulting from surface evaporation were reduced by means of a special preparation of the sample before the vacuum treatment. Metallographic and radiocrystallographic examinations were carried out on the alloys. A dilatometric method was devised for the rapid determination of the solidus temperature in the Al-rich region; the use of this method was made possible by means

of a high sensitivity, instant-reading electrical inductive-trap dilatometer. The eutectic $NbAl_3$–Al reaction and the eutectic reaction between the compounds $NbAl_3$ and $Nb_2Al$ were confirmed. It was possible to identify the $Nb_2Al$ and $Nb_3Al$ phases in the Nb-rich region. The equilibrium of the phases in this region was, however, found to be more complicated than reported in previous publications, since it must in particular account for solid-state transformations in the intermetallic compounds. (auth)

**18744** (GA-3367) THERMALLY ACTIVATED DISLOCATION MOTION IN FCC AND REFRACTORY BCC METALS. R. H. Chambers (General Atomic Div. General Dynamics Corp., San Diego, Calif.). Aug. 12, 1962. Contract AT(04-3)-167. 7p.

Amplitude-dependent internal friction evidence is presented which demonstrates the strong differences in dislocation mobility which exist between the two classes of cubic metals: the face-centered cubic, represented by Al and Cu, and the body-centered cubic, represented by Ta, Nb, Mo, and W. Amplitude-dependent internal friction due to dislocation motion results from the hysteretic unpinning and repinning of dislocation loops from impurity pinning points when the oscillating measuring stress exceeds the breakaway stress value. Results of experiments indicate that the modulus defect measured at 4.2°K in the fcc metals is considerably larger than that associated with the Bordoni peak alone, while the modulus defect measured at 4.2°K in the refractory bcc metals is quite small compared with that associated with the deformation peaks along. (H.G.G.)

**18745** (HE-150-204) OPTICAL STRAIN MEASUREMENTS IN STAINLESS STEEL AT TRANSIENT TEMPERATURES TO 2000°F (thesis). Claude Lawrence Arne (California. Univ., Berkeley. Inst. of Engineering Research). Dec. 20, 1962. For California. Univ., Livermore. Lawrence Radiation Lab. Contract W-7405-eng-48. 82p. (UCRL-13080)

Type 304 stainless steel plate specimens $0.24 \times 2\frac{1}{4} \times 4$ in. in size were subjected to stagnation heating in an oxyacetylene flame apparatus. Transient thermal strains at temperatures up to 2000°F were measured with a modified Tukerman optical strain gage shielded from heat transfer by a water cooled radiant heat shield. The general equations of thermoelasticity are developed for a flat homogeneous plate subjected to a particular transient three-dimensional temperature distribution. The experimentally determined temperatures in the specimens were used in the analytic solution for thermal strains which were found to agree very well with the optically measured strains on the unheated specimen surface. (auth)

**18746** (HW-75484) THE NOTCH SENSITIVITY OF ASTM A-212 GR. B STEEL AND PIPE WELDS UNDER REVERSED CYCLE LOADING. W. J. Love (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Nov. 15, 1962. Contract AT(45-1)-1350. 34p.

The results of reversed-cycle fatigue tests of ASTM A-155 Class I Gr. KC70 pipe weldments and base materials under various surface conditions and with artificial flaws are presented. These tests were carried out to provide additional bases for predicting the effect of weldment flaws upon fatigue strength. Fatigue specimens were made up from 2-in.-long ring sections of 18-in.-OD, 1.18-in.-thick seam-welded pipe which was rejected for fabrication into the NPR primary loop. Testing was accomplished with a special bending fatigue test machine composed of a 210° segment of the ring specimen with masses located at each extremity excited at its natural frequency of approximately 50 cps by a shake table. Twenty-five specimens were modified with sharp "V" notches to $\frac{1}{8}$-in. depth machined into the weld, heat affected zone, or base metal. Five specimens were made up with $\frac{3}{16}$-in.-deep cracks in the form of "lack of penetration" weldments. Fatigue strength data from these specimens were compared with data from sound weld and base metal specimens having "as-received" and polished surfaces. Fatigue stresses ranged to 45,000 psi and fatigue lives to $3 \times 10^6$ cycles. The results showed the material to be relatively insensitive to mechanical notches. The fatigue sensitivity of the material to the various flaw conditions was expressed in the form of a stress concentration or (when the elastic stress concentration factor could be computed) notch sensitivity factor. (auth)

**18747** (HW-SA-2640) MELTING BEHAVIOR IN THE SYSTEM $UO_2$–$PuO_2$. T. D. Chikalla (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). June 13, 1962. Contract AT(45-1)-1350. 28p.

The melting points of $UO_2$ and $PuO_2$ in a helium atmosphere were found to be 2730 ± 30°C and 2280 ± 30°C, respectively. With the exception of a melting maximum at the composition $UO_2$–10 wt. % $PuO_2$, the liquidus exhibits good continuity and agrees well with that calculated from thermodynamic data. X-ray diffraction data on melted $PuO_2$ and $UO_2$–$PuO_2$ solid solutions indicate that oxygen is evolved during melting, but that no reduction to a second-phase plutonium suboxide occurs. The oxygen-to-plutonium atomic ratio of melted $PuO_2$ is 1.62. Lattice parameters of melted $UO_2$–$PuO_2$ samples vary linearly with composition, but are approximately 0.2 per cent greater than anticipated. (auth)

**18748** (LADC-5143) NONSTOICHIOMETRY IN INTERMETALLIC COMPOUNDS. Guy R. B. Elliott and Joe Fred Lemons (Los Alamos Scientific Laboratory, N. Mex.). [1962]. Contract [W-7405-eng-36]. 22p.

The relation of defect concentrations in a solid lattice to nonstoichiometry is discussed for intermetallic compounds. Experimental studies were made of the changes in vapor pressure with composition more precisely than was possible with earlier techniques. These observed changes allowed checking of postulated physical models for the manner in which the parent lattice changes with changes of composition. Results of studies of Ce–Cd alloys are discussed. (M.C.G.)

**18749** (LADC-5218) RATES AND MECHANISMS OF THE LOSS OF FISSION PRODUCTS FROM URANIUM–GRAPHITE FUEL MATERIALS. E. A. Bryant, G. A. Cowan, J. E. Sattizahn, and Kurt Wolfsberg (Los Alamos Scientific Lab., N. Mex.). [1961]. Contract [W-7405-eng-36]. 24p.

Evidence concerning high-temperature loss of fission-product atoms from U–graphite fuel material is presented. Results indicate that no single model can adequately describe the behavior of all fission-product elements. Variables which affect loss rates are temperature, chemical species or element, sample dimensions, U concentration, fabrication, and graphite porosity. Loss-rate processes are discussed. (J.R.D.)

**18750** (MSAR-59-133) EFFECT OF 1200°F SODIUM ON AUSTENITIC AND FERRITIC STEELS. THERMAL SHOCK, NITRIDING, STRESSED CORROSION: UNSTRESSED CORROSION. Bi-Monthly Progress Report No. 2, September–October 1959. (MSA Research Corp., Callery, Penna.). Dec. 4, 1959. Contract AT(11-1)-765. 61p.

The test loop in which corrosion specimens will be run has been designed. Construction is proceeding at as rapid

a rate as can be maintained depending upon receipt of materials. The final design of the nitriding and thermal shock test loops is nearing completion. The stressed and unstressed corrosion test will be carried on in the same system as originally planned by MSAR. The nitriding system was redesigned to eliminate the parallel test sections so that the distance from the sodium–nitrogen interface would be increased. The thermal shock system has been designed to provide a temperature gradient in the test section from 1200 to 500°F in 20 seconds. All the specimens have been received except for the 9 Cr–1 Mo steel needed for the thermal shock test. The specimen design, treatment and identification were finalized. Corrosion tests will be run with the constant load sample stress to be twice the ASME Boiler Code allowable stress at 1200°F. The flow rate was set at 0.5-1 ft/sec. (auth)

**18751** (MSAR-62-33) EFFECT OF 1200°F SODIUM ON AUSTENITIC AND FERRITIC STEELS. PART I. PHYSICAL PROPERTIES OF MATERIALS. PART II. THERMAL SHOCK. Progress Report No. 19, March 1962. R. C. Andrews (MSA Research Corp., Callery, Penna.). Apr. 18, 1962. Contract AT(11-1)-765. 19p.

The nineteenth in a series of progress reports (March 1962) on the status of physical properties study of stainless steel exposed to Na at 1200°F is presented. Results of all the tests performed by the end of this report period (March 1962) for the physical properties of materials program are reported in tabular form. Changes recommended by the AEC Subcommittee are included. (H.G.G.)

**18752** (MSAR-62-41) EFFECT OF 1200°F SODIUM ON AUSTENITIC AND FERRITIC STEELS. PART I. PHYSICAL PROPERTIES OF MATERIALS. PART II. THERMAL SHOCK. Progress Report No. 20, April 1962. R. C. Andrews (MSA Research Corp., Callery, Penna.). May 16, 1962. Contract AT(11-1)-765. 10p.

The twentieth in a series of progress reports on the effects of 1200°F sodium on the physical properties of stainless steel is presented. All of the test machines at MSAR were in operation during April 1962. Plots of the stress to rupture data and for the fatigue tests for the Cr–Mo steel and stainless steel specimens are presented. Indications of uniformity and consistency are apparent. The results of all the tests performed are reported in tabular form. (H.G.G.)

**18753** (MSAR-62-50) EFFECT OF 1200°F SODIUM ON AUSTENITIC AND FERRITIC STEELS. PART I. PHYSICAL PROPERTIES OF MATERIALS. PART II. THERMAL SHOCK. Progress Report No. 21, May 1962. (MSA Research Corp., Callery, Penna.). June 11, 1962. Contract AT(11-1)-765. 13p.

The twenty-first in a series of monthly progress reports on the effects of 1200°F sodium on the physical properties of stainless steel is presented. All test machines at MSAR were in operation during May 1962. Plots of the stress to rupture data and plots for the fatigue tests for the Cr–Mo steel and stainless steel specimens are included. The results of all tests performed are presented in tabular form. (H.G.G.)

**18754** (MSAR-62-77) EFFECT OF 1200°F SODIUM ON AUSTENITIC AND FERRITIC STEELS. PART I. PHYSICAL PROPERTIES OF MATERIALS. PART II. THERMAL SHOCK. Progress Report No. 22, June 1962. (MSA Research Corp., Callery, Penna.). July 16, 1962. Contract AT(11-1)-765. 20p.

The twenty-second in a series of monthly progress reports on the effects of 1200°F sodium on the physical properties of stainless steel is presented. All test machines at MSAR during June 1962 were in operation. Plots of the stress to rupture data for the Cr–Mo steel and stainless steel specimens are included. The results of some of the tests performed are reported in tabular form. A discussion of the analytical procedures is also included. (H.G.G.)

**18755** (MSAR-62-92) EFFECT OF 1200°F SODIUM ON AUSTENITIC AND FERRITIC STEELS. PHYSICAL PROPERTIES OF MATERIALS. Progress Report No. 23, July 1962. (MSA Research Corp., Callery, Penna.). Aug. 15, 1962. Contract AT(11-1)-765. 24p.

Progress attained during July 1962 in the program to determine the effects of 1200°F sodium on the physical properties of stainless steel and Cr–Mo steel is presented. A schematic of the test loop for conducting the fatigue, creep, and stress rupture tests is shown. The operational histories of both test loops are represented graphically. A summary of all tests completed and in progress is included. Stress rupture, creep, and tensile tests in air and helium are being conducted by the University of Michigan. (H.G.G.)

**18756** (MSAR-63-47) EFFECT OF 1200°F SODIUM ON AUSTENITIC AND FERRITIC STEELS. Progress Report No. 30, February 1963. (MSA Research Corp., Callery, Penna.). Mar. 15, 1963. Contract AT(11-1)-765. 12p.

Results of a physical property study of type 316 stainless steel and Cr–Mo steel are presented. Fatigue tests, stress rupture tests, creep tests, and tensile tests for specimens exposed to air, He, and Na at high temperatures are discussed. A study of carbon solution rates in Na is also discussed. Results indicate that specimens exposed to high temperature Na experience significant reductions in tensile and yield strengths. Results of the metallurgical examination of seven specimens of type 316 stainless steel are presented. (H.G.G.)

**18757** (NAA-SR-Memo-7861) HIGH TEMPERATURE IN BERYLLIUM OXIDE. Stanley B. Austerman (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Oct. 31, 1962. Contract [AT(11-1)-Gen-8]. 10p.

The existence of a phase transition in beryllium oxide was revealed by various phenomena studied at several laboratories. The transition temperature is approximately 2050 to 2100°C. X-ray diffraction and physical expansion data were obtained recently with single crystals, and previously published x-ray diffraction data re-evaluated. These indicated that the crystal structure of the high temperature form can be described as a hexagonal unit cell with dimensions (at ~2100°C) of a = 5.49 Å and c = 4.75 Å. The hexagonal unit cell may be described alternatively as tetragonal with proper choice of axes. This structure is closely related to the normal, low-temperature crystal structure of BeO. (auth)

**18758** (NAA-SR-Memo-8052) LINEAR EXPANSION AND MECHANICAL PROPERTIES OF SELECTED NUCLEAR REACTOR GRID PLATE MATERIALS FOR THE TEMPERATURE RANGE 70-2000°F. Jerome G. Wendt (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Dec. 20, 1962. Contract [AT(11-1)-Gen-8]. 39p.

The mechanical and linear expansion properties of various commercially available alloys have been tabulated to aid in the selection of reactor grid plate materials. The linear expansion data are presented in graphical form

over the temperature range 70 to 2000°F when such data are available. All the materials are compatible with $H_2O$, NaK, Na, and K. (auth)

**18759** (NAA-SR-Memo-8055) COMPATIBILITY OF BORON CARBIDE WITH POTENTIAL AOMR CONTROL ROD CLADDING MATERIALS. R. D. Hahn (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Jan. 31, 1963. Contract [AT(11-1)-Gen-8]. 20p.

The solid state compatibility of boron carbides with commercial copper, Types 304 and 430 stainless steels, and AISI 4130 steel was investigated. The diffusion couples were hot pressed under dynamic vacuum at 1200°F for 4 hours to attain good initial contact. Heat treatments were conducted at temperatures of 750, 950, 1100, and 1300°F for periods of 500, 1000, 5000, and 10,000 hours. The results of these studies showed the commercial copper and Type 430 stainless steel to be compatible with stoichiometric boron carbide over the time and temperature ranges used. Type 304 stainless steel was shown to be compatible for 10,000 hours up to 1100°F but not at 1300°F. There was no reaction observed in the 4130 steel for 10,000 hours at 750°F but a very hard reaction zone, which increased in width from 1 mil to 10 mils with increasing temperature from 950 to 1300°F, was observed. The phase formed in the 4130 steel was identified to be primarily $Fe_2B$. The activation energy for the growth of this phase was calculated to be ~38 kcal/mole. (auth)

**18760** (NMI-2114) FUNDAMENTAL AND APPLIED RESEARCH AND DEVELOPMENT IN METALLURGY. Progress Report to United States Atomic Energy Commission, January 1963. (Nuclear Metals, Inc., Concord, Mass.). Apr. 12, 1963. Contract AT(30-1)-2784. 23p.

A review of the progress attained during Jan. 1963 in metallurgy research at Nuclear Metals, Inc. is presented. Discussions of the fundamentals of single crystal deformation is zone-refined beryllium, high-temperature properties of refractory metal alloys, development of uranium-base alloys, and the extrusion of tungsten tubing are presented. (H.G.G.)

**18761** (NP-12652) REFRACTORY BINARY BORIDES. Technical Report No. 6. Ben Post (Brooklyn. Polytechnic Inst.). [1962]. Contract Nonr-839(12). 67p.

A review on the preparation of borides and classification of boride structures is presented. The crystal chemistry of borides with two- and three-dimensional boron networks is described. The metal-boron systems, including borides of the alkali and alkaline earth metals, borides of rare earth metals and actinides, and borides of the transition metals of groups IV, V, VI, VII, and VIII are discussed in detail. The thermal, mechanical, magnetic, electrical, and bonding properties of borides are also presented. (158 references). (H.G.G.)

**18762** (NP-12668) UNTERSUCHUNG DER DIFFUSION VON EDELGASEN IN FESTKÖRPERN. (Diffusion of Fission Gases in Solids. First Quarterly Report, July 1–September 30, 1960). (Hahn-Meitner-Institut fur Kernforschung, Berlin). Nov. 26, 1960. Contract EUR/C/710/2/6od. 13p.

Work was carried out on the planning and construction of apparatus as well as procurement of the initial materials. Preliminary studies were made on potassium halide–Ar, $UO_2$–Xe, and UC–Xe systems. The first results with potassium halogenides proved the applicability of these systems, while the potassium salts of aliphatic carboxylic acids on the basis of previous experience did not seem to be suited for the planned diffusion studies. Preliminary tests and standardizations were carried out on the apparatus for the $UO_2$ and UC systems. (tr-auth)

**18763** (NP-12669) UNTERSUCHUNG DER DIFFUSION VON EDELGASEN IN FESTKÖPERN. (Diffusion of Fission Gases in Solids. Second Quarterly Report, October 1–December 31, 1960). (Hahn-Meitner-Institut fur Kernforschung, Berlin). Contract EUR/C/710/2/6od. 15p.

The first results were obtained on single crystals of KF, which should serve as a model system for the method of activation-diffusion and for testing the theory of Inthoff and Zimen. For pressed tablets of powdered KF heating curves were different than those for the single crystals. The interpretation of this difference appears to be an essential task for further work, since it can be supposed that from this it will be possible to infer results for systems of interest to nuclear technology. The first measurements were carried out on $UO_2$ and UC systems. On the basis of practical experience, the apparatus and the measurement methods can be improved. For the $ThO_2$ system preliminary irradiations were made on samples for diffusion studies. (tr-auth)

**18764** (NYO-9047) DIFFUSION OF KRYPTON THROUGH URANIUM CARBIDE. Final Report. J. J. Weinstock, A. P. Pinkerton, and K. D. Ziegel (Radiation Applications Inc., Long Island City, N. Y.). Jan. 10, 1961. Work Performed under United States–Euratom Joint Research and Development Program. Contract AT(30-1)-2497. 22p. (EURAEC-19)

An experimental apparatus and technique were developed to study the rate of diffusion of gases in refractory materials in the temperature range 1000 to 2500°C. The effect of temperature on the diffusion coefficient for krypton in uranium monocarbide was determined. It is represented by the equations: $D' = 2.41 \times 10^5\, e - (80{,}000)/(RT)\ sec^{-1}$ or, $D = 0.0142\, e - (80{,}000)/(RT)\ cm^2\text{-}sec^{-1}$. Experimental and theoretical difficulties in the study of diffusion at high temperatures are discussed. (auth)

**18765** (NYO-10354) A STUDY OF INCLUSIONS IN URANIUM. Final Report. George L. Kehl and Eric Mendel (Columbia Univ., New York. Henry Krumb School of Mines). [1963]. Contract AT(30-1)-1593. 37p.

The nonmetallic inclusions, UN, UC, U(C,N), and U(C,N,O), in uranium metal were studied. Because of the low solubility of elements in $\alpha$ uranium, it was necessary to conduct heat treatments in the $\gamma$ uranium region to secure any measurable changes in the inclusions in a reasonable time at temperature. The transformations were therefore studied as a function of time at 810 and 1090°C. All the inclusions possessed the same face-centered cubic (NaCl) structure. It was found that UN inclusions may exist metallographically as a fine dispersion, as short elongated particles that may form a Widmanstatten pattern, as irregularly shaped angular particles, or in dendritic form. This inclusion is highly resistant to air oxidation in normal atmospheres and to discoloration by 1:1 $HNO_3$–$H_2O$ reagent. For metallographic identification purposes, the nitride phase was continuously covered with an electrodeposit of copper after about 5 sec. UC readily discolored after metallographic polishing in normal atmosphere, and became completely blackened in 1:1 $HNO_3$–$H_2O$ reagent within 30 sec. Inclusions of UC were not always receptive to electrodeposited copper. Inclusions of U(C,N,O) were characterized by a core either partially or completely surrounded by a rim phase. It was unaffected by air oxidation and by immersion in 1:1 $HNO_3$–$H_2O$ reagent. It was unreceptive to an electrodeposit of copper. U(C,N) was found to exist in

massive form or as a phase surrounding $UO_2$. The inclusion when in massive form was invariably surrounded by a phase of either UN or U(C,N) higher in nitrogen content than the core. In many respects it behaves similarly to UN. (M.C.G.)

**18766** (TID-16676) THE DIFFUSION OF LITHIUM IN ALUMINUM. L. P. Costas (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). [Sept. 1962]. Contract AT(07-2)-1. 7p.

Aluminum–LiAl diffusion couples were studied to determine the diffusion of lithium in aluminum at various temperatures. The values for the activation energy, E, and the diffusion factor, $D_0$, were found to be 33.3 kcal/mole and 4.5 $cm^2$/sec, respectively. (auth)

**18767** (TID-16688) VARIATION OF THE SURFACE OPTICAL PROPERTIES OF SILVER CRYSTALS WITH VACUUM ANNEALING AND ARGON-ION BOMBARDMENT. A. T. Fromhold, Jr. (Sandia Corp., Albuquerque, N. Mex.). [Aug. 1962]. Contract AT(29-1)-789. 35p. (SCDC-2836)

The optical constants of silver single crystals were observed to vary irreversibly with surface treatments of vacuum annealing and argon-ion bombardment. Although the dependence on surface treatment is not simple, some qualitative effects are the same for the (111) and (110) faces. The results show that the surface structure of silver is severely disarranged by cycles of vacuum annealing and argon-ion bombardment. (auth)

**18768** (TID-16706) SPALL FRACTURE. C. Donald Lundergan (Sandia Corp., Albuquerque, N. Mex.). [Sept. 1962]. Contract [AT(29-1)-789]. 25p. (SCDC-2845)

The reported spall thresholds in copper (the upper and lower fracture, and the separation) are discussed in relation to the stress-time history in the region of failure and to the experimental techniques used to induce the shock waves. Also considered are the dynamic properties under uniaxial strain and the geometry of the medium which influences the fracture and separation spall thresholds in polycrystalline metals. Some suggestions are made on using the various approaches of determining spall thresholds to obtain more information about the microscopic and structural behavior of media subjected to short-time intense impulsive loads. (auth)

**18769** (TID-18334) HIGH TEMPERATURE THERMAL PROPERTIES OF HELIUM AND OTHER FLUIDS. Progress Report, June 1, 1962 to May 31, 1963. Charles F. Bonilla (Columbia Univ., New York). Mar. 1, 1963. Contract AT(30-1)-2660. 19p.

Preliminary results which were obtained of the high temperature thermal conductivity and viscosity of helium are reported. The critical temperature determination of cesium went through the stage of apparatus construction, and a cell calibration run without cesium was completed. Measurements of the vapor pressure of cesium and rubidium carried out prior to this year were re-evaluated on a digital computer to obtain their best interpretation, and the results are presented. Prior measurements of the thermoelectric potential (Seebeck effect) of alkali metals were further analyzed thermodynamically, to separate the Peltier and Thomson effects. All of this liquid metal work is applicable in the study of the critical temperatures of alkali metals, as well as having many other more general uses. (auth)

**18770** (TID-18341) MAGNETORESISTANCE OF THE ALLOY $Cu_3Au$. Robert B. Gordon (Yale Univ., New Haven). Feb. 1963. Contract AT(30-1)-2029. 16p.

Experiments were conducted to determine the dependence of the low-field magnetoresistance on domain size by measuring the magnetoresistance of $Cu_3Au$ wire, heat treated to produce different domain sizes. Results of these experiments substantiate the interpretation of the dependence of the transport properties of $Cu_3Au$ on the antiphase domain structure. The greatest uncertainty in this work is in the x-ray determination of the antiphase domain size. A considerable gap in the theoretical understanding of the interaction of electrons with antiphase domain boundaries also exists. (H.G.G.)

**18771** (TID-18387) NON-DESTRUCTIVE MEASUREMENTS FOR DETERMINING THE ADEQUACY OF A DIELECTRIC. Herbert F. Vogel (Argonne National Lab., Ill.). Jan. 7, 1963. Contract [W-31-109-eng-38]. 15p. (UAC-7203)

A testing program to determine the adequacy of a dielectric is discussed. Deficiencies are: failure due to insufficient intrinsic dielectric strength, breakdown initiated by thermal runaway, and breakdown initiated by gas discharges. A formula for the thermal runaway voltage and the formula for the temperature distribution due to dielectric losses are derived. The best and most sensitive test for detecting gas discharges is a corona test made with a suitable instrument. If the specimen has large capacitance, the sensitivity of a detector responding to high-frequency corona noise is inherently low because of the masking effect of the capacitance. This effect is overcome by the device described, which has successfully been used on the Ring Magnet Coils for the 12.5-Bev Zero Gradient Synchrotron built for the Argonne National Laboratory. (auth)

**18772** (TID-18412) FUNDAMENTAL STUDIES IN HIGH TEMPERATURE MATERIALS PHENOMENA. SCOPE I. HIGH TEMPERATURE-PRESSURE PHYSICAL PROPERTY MEASUREMENTS. M. E. Bell, W. R. Buessem, Rustum Roy, and C. C. Crowe. SCOPE II. ELECTRICAL RESISTIVITY MEASUREMENTS OF MATERIALS IN RELATION TO HIGH TEMPERATURE TRANSFORMATIONS. G. W. Brindley. SCOPE III. TRANSFORMATIONS IN $AB_2$ INTERMETALLIC COMPOUNDS. Annual Progress Report, March 12, 1963. (Pennsylvania State Univ., University Park. Coll. of Mineral Industries). Contract AT(30-1)-2581. 162p.

Progress on high-temperature and high-pressure physical property measurements, electrical resistivity measurements of materials in relation to high-temperature transformations, and studies of transformations in $AB_2$ intermetallic compounds is reported. Highly sensitive equipment for the noncontact rotating field method of measuring dielectric loss was designed and constructed. Pyroelectric measurements on high-permittivity relaxation materials demonstrated ferroelectric properties in the system examined. Work on the Ti–O system produced the first clear indication of position of the Magneli phases in the oxygen pressure-temperature diagram. A computer program was developed for determining the fugacity of one component in a gaseous buffer mixture. In the spectroscopic studies, a wide-ranging survey showed that the infrared spectra may be successfully used as a tool to determine the coordination of the metal ion in simple oxide structures. Development of a modified hot-wire method for measuring thermal conductivity was completed. Electric resistivity measurements were made on ZnO, $Cr_2O_3$, and ZnO–$Cr_2O_3$ systems. Major emphasis was placed on d-c measurements. Work on the structure of $ThZn_2$ was carried out. It was found to exhibit a structure that is isostructural with $CeCu_2$. (M.C.G.)

**18773** (TID-18433) SOLID SOLUTIONS IN COPPER–IRON ALLOYS. Technical Report No. 13. William Klement, Jr. (California Inst. of Tech., Pasadena. W. M. Keck Lab. of Engineering Materials). Mar. 1963. Contracts AT(04-3)-221 and Nonr-220(30). 16p.

By rapidly quenching liquid alloys, single-phase copper-rich solid solutions were obtained from 0-20 at. % Fe. The plot of lattice spacings vs. composition exhibits a distinct maximum near 7.2 ± 0.5 at. % Fe and this extremum is tentatively associated with a magnetic transition. Body-centered cubic iron-rich phases containing about 5-10 at. % copper coexist with face-centered cubic copper-rich phases of rather widely varying compositions in the range, 20-about 80 at. % Fe. At least 10 at. % Cu is retained in solid solution in the iron-rich phase, for which the lattice spacing increases by $1.1 \pm 0.1 \times 10^{-3}$ Å per at. % Cu. (auth)

**18774** (TID-18434) BASIC RESEARCH IN CERAMICS AND NONCRYSTALLINE SYSTEMS. Annual Report. W. D. Kingery, R. L. Coble, A. R. Cooper, Jr., and T. R. Clevenger, Jr. (Massachusetts Inst. of Tech., Cambridge. Dept. of Metallurgy). Mar. 30, 1963. Contract AT(30-1)-2574. 21p.

Progress in the ceramic research program including studies on sample preparation, kinetic processes at elevated temperatures, development of ceramic microstructures, relation of properties to crystal structure and microstructure, and the structure and properties of noncrystalline solids is presented. A list of the technical publications which have resulted from this ceramic research program during 1962 is included. (H.G.G.)

**18775** (UCRL-6816-T) INTERMETALLIC 2-17 STOICHIOMETRY. Quintin C. Johnson (California. Univ., Livermore. Lawrence Radiation Lab.). Aug. 3, 1962. Contract [W-7405-eng-48]. 8p.

It is noted that the 2-17 stoichiometric ratio was reported for a number of intermetallic phases. A survey of the literature shows that most of these phases are probably isomorphous with either the $Th_2Zn_{17}$ or the $Th_2Ni_{17}$ structures. Thirteen intermetallics with 2-17 stoichiometry, rhombohedral symmetry, and C/a ratios close to that occurring in $Th_2Zn_{17}$ are tabulated. Twelve intermetallics with 2-17 stoichiometry, hexagonal symmetry, and C/a ratios close to that occurring in $Th_2Ni_{17}$ are also tabulated. Comments concerning these data are included. (J.R.D.)

**18776** (UCRL-6984) GRAIN SIZE MEASUREMENTS IN URANIUM BY USE OF ULTRASONICS. H. L. Dunegan (California. Univ., Livermore. Lawrence Radiation Lab.). July 2, 1962. Contract W-7405-eng-48. 35p.

Ultrasonic attenuation and velocity measurements were made on polycrystalline U specimens of varying grain size. The major contribution to the attenuation is shown to be the result of a scattering mechanism created by the anisotropic grain orientation. It is also shown that this attenuation is very sensitive to small changes in grain diameter and thus can be used as a quantitative nondestructive measurement of grain size. The attenuation as a function of average grain diameter can be expressed by the equation $a = Ae^{kD}$, where a = the attenuation in db/$\mu$sec, A = a frequency-dependent constant, $k = 1.17 \times 10^3$ db/$\mu$sec-inch, and D = the average grain diameter in in. A description of the specimens, mechanical fixturing, and electronic instrumentation for making these measurements is given. Some basic theory on the attenuation of sound in solids is also included. (auth)

**18777** (AEC-tr-5723) COMPARISON OF SILVER-ACTIVATED METAPHOSPHATE GLASSES OF VARIOUS MANUFACTURERS. [PART] II. Becker (Kernforschungsanlage, Jülich, Germany). Translated for Oak Ridge National Lab., Tenn. Feb. 10, 1963. 12p.

In continued comparisons of melts copied from Japanese and American dosimeter glasses with original glasses, the sensitivity of the original glasses as well as their low statistical dispersion can be nearly attained and partly even surpassed. It is evidently still not possible to come even close to the low zero effect of the Japanese glasses, that determines the accuracy of measurements of smaller dose rates (less than 1-10 r). The "predoses" of the copied melts were higher by a factor of 15-45. (auth)

**18778** (AEC-tr-5726) MAGNETIC PROPERTIES OF DILUTE ALLOYS. MAGNETIC INTERACTIONS AND ANTIFERROMAGNETISM IN ALLOYS OF THE NOBLE METAL-TRANSITION METAL TYPE. A. Blandin and J. Friedel. Translated by G. Riese and William Steyert (Los Alamos Scientific Lab., N. Mex.) from J. Phys. Radium, 20: 160-8(Feb. 1959). 28p.

The electronic structure of disordered alloys of transition elements at low concentrations was investigated, and a classification of their magnetic properties is presented. A model of magnetic interaction between impurities is proposed to explain the antiferromagnetic properties of some such alloys (Cu–Mn). (H.G.G.)

**18779** (TRG-Inf-Ser-6) RUPTURE OF METALS AS THE RESULT OF THE INTERACTION OF DISLOCATIONS. I. A. Oding. Translated by R. Hardbottle (U.K.A.E.A. Risley, Lancs, Eng.) from Izv. Akad. Nauk SSSR, Otd. Tekhn. Nauk, Met i Toplivo, No. 3, 3-16(1960). 16p.

The process of rupture of metals can be considered as being the result of interaction between the force fields surrounding dislocations or as the result of a stress concentration around the foremost dislocation in cases where a horizontal row of dislocations forms. Some plans are given of arrangements of dislocations in which interaction between the dislocations leads to the maximum unit energy of elastic deformation. It is proposed that the criterion of the rupture of metals be taken as the limiting unit energy of elastic deformation, which equals the latent heat of fusion. A mechanism of crack growth is presented, based on the presence at the sharp end of the crack of a dislocation reacting with other dislocations passing near it. The dislocation width may be of great importance in the exhibition of brittle fracture by metals. (auth)

**18780** (TRG-Inf-Ser-107) ON THE INVESTIGATION OF PARTICLE SIZE AND LATTICE DISTORTION BY X-RAY REFLECTIONS. V. Hauk and C. Hummel. Translated by H. W. Curtis (U.K.A.E.A. Risley, Lancs, Eng.) from Z. Metallk., 47: 254-60(1956). 14p.

The effects of cold pressing of cast iron and steel on particle size and lattice distortions of ferrite crystals were determined by measuring the x-ray reflections with a goniometer combined with a Geiger counter. This method of determining these values from the width of the x rays, yields values which are considerably different from those obtained by using the first Fourier coefficients of the distribution of intensity. The differences are attributed to the inaccuracy of intensity recording within the range of the basis of the rays. A comparison is made of the values for particle size obtained by the microbeam method and by x-ray width measurement. (H.G.G.)

**18781** (UCRL-Trans-913(L)) THE PHASE DIAGRAM FERROUS OXIDE–ALUMINUM OXIDE. Wilhelm Anton Fischer and Alfred Hoffmann. Translated by Sergey

Shewchuck (Univ. of California, Lawrence Radiation Lab., Livermore) from Arch. Eisenhuettenw., 27: 343-6(1956). 14p.

Thermoanalysis, microscopic, and x-ray studies were conducted to determine the phase diagram of $FeO-Al_2O_3$. The ferrous oxide forms, with the spinel $FeO \cdot Al_2O_3$ at ~5% $Al_2O_3$, a eutectic with a melting point of 1330°C. The melting point of the spinel is 1780°C. It forms mixed crystals with the aluminum oxide at temperatures from 1500 to 1750°C. The highest aluminum oxide content of the spinel is 64.2% at 1750°C. The mixed crystals with the aluminum oxide forms a eutectic at 65% $Al_2O_3$ with a melting temperature of 1750°C. The aluminum oxide dissolves 1.5% FeO at 1500°C, and 6.5% FeO at 1750°C. During this mixed crystal formation, the lattice values vary in rhombohedral coordinates from a = 5.128 ± 0.001 Å, $\alpha$ = 55°17′ ± 1′ for pure $\alpha$-$Al_2O_3$ to a = 5.140 ± 0.002 Å and $\alpha$ = 55°17′ ± 1′ for $\alpha$-$Al_2O_3$ saturated in ferrous oxide. Metallic iron appears in the structure picture below ~25% $Al_2O_3$, and a mixed crystal between spinel and magnetite with 39 to 63 mol % $Fe_3O_4$ appears at higher aluminum oxide contents. The mixed crystal formation results from the slight portion of trivalent iron which is constantly present in the ferrous oxide. (auth)

**18782** $Nb_3Si$, A SUPERCONDUCTOR WITH THE ORDERED $Cu_3Au$ STRUCTURE. Francis Galasso and Jane Pyle (United Aircraft Corp., East Hartford, Conn.). Acta Cryst., 16: 228-9(Mar. 10, 1963).

The preparation and structure of $Nb_3Si$ were studied. The Nb and Si powders (99% purity) were mixed dry in stoichiometric quantities, pressed into pellets, and heated at 1100°C for 140 hr. X-ray diffraction patterns were obtained and the structure was found to be the same as that of ordered $Cu_3Au$. It was found to become superconducting at 1.5°K. (M.C.G.)

**18783** ZIG-ZAG TWINS IN ZIRCONIUM. R. E. Reed-Hill and E. R. Buchanan (Univ. of Florida, Gainesville). Acta Met., 11: 73-5(Jan. 1963).

The twinned structure in zirconium was analyzed to determine its crystallographic features. Five grains containing cross-twinning were analyzed in detail and the stress conditions for their formation are summarized. Pronounced zig-zag twinning occurs in grains so aligned to the stress axis as to place several adjacent (1121) twinning planes under large, nearly equal shear stresses. (P.C.H.)

**18784** THE EFFECT OF HELIUM ON RECRYSTALLIZATION AND GRAIN BOUNDARY MOVEMENT IN ALUMINUM. C. E. Ells (Atomic Energy of Canada Ltd., Chalk River, Ont.). Acta Met., 11: 87-96(Feb. 1963).

A layer of helium-containing material was formed in samples of cold-worked aluminum by cyclotron $\alpha$-particle irradiation, and this layer was used to observe the effect of helium on subsequent recrystallization and grain growth in the samples. Helium concentrations $>10^{-4}$ at. % severely inhibited recrystallization of the layer during post-irradiation heating of the samples, and helium-filled bubbles inhibited grain boundary movement in recrystallized aluminum. Helium concentrations $<10^{-5}$ at. % had little effect on either recrystallization or grain boundary movement. Addition to the aluminum of impurities other than helium tended to reduce the inhibiting effect of helium on recrystallization. Calculations indicate that the inhibition of recrystallization was not due to the presence of helium-filled bubbles of radii $>10^{-6}$ cm; it must have arisen either from individual helium atoms in solution or from small clusters of helium atoms. (auth)

**18785** NUCLEAR MAGNETIC RESONANCE IN INTERMETALLIC COMPOUNDS. H. E. Schone (Boeing Scientific Research Labs., Seattle) and W. D. Knight. Acta Met., 11: 179-86(Mar. 1963).

The nuclear magnetic resonance is observed in a series of intermetallic compounds of structure type NaTl, including NaTl, LiAl, LiGa, and LiIn. Motional narrowing of the dipolar part of the Li resonance line is observed in all the compounds from which the activation energy of diffusion of Li is estimated to be 0.15 ev. The low value of the activation energy in this defect lattice is associated with a 3 per cent vacancy concentration in the lithium sublattice. Motional averaging of quadrupole interactions is observed for both the Li and Al lines in LiAl. The magnitudes of the quadrupole couplings $e^2qQ/h$ produced by a nearest-neighbor vacancy are 0.36 Mc for $Li^7$ and 29 Mc for $Al^{27}$. Second-order broadening obliterates the Ga and In resonances in LiGa and LiIn below 200°K. It is estimated that the quadrupole couplings are of order or greater than 30 Mc and 80 Mc for $Ga^{71}$ and $In^{115}$, respectively. The size of the quadrupole interaction is consistent with a high degree of covalency in these crystals. The frequency shifts, relative to diamagnetic chemical compounds, are found to be (in per cent): Li (<0.005), Al (<0.01), Ga (0.09), In (0.13), Na (−0.016), Tl (−0.50). (auth)

**18786** THE DEFORMATION STACKING FAULTS IN F.C.C. METALS: THE CASE OF THORIUM. V. A. Arunachalam and K. Tangri (Atomic Energy Establishment, Trombay, India). Acta Met., 11: 223-5(Mar. 1963).

Experiments were repeated on 76% cold-rolled thorium to check McHargue's discovery of a high stacking fault density in cold-rolled thorium. No peak shifts were detected in the x-ray line broadening, and it is suggested that McHargue's results are in error. The theory of stacking faults in metals is discussed, and the correlation of the fiber texture with the stacking fault energy is considered. It is concluded that the available evidence points towards the absence of deformation stacking faults in cold-rolled thorium. (D.L.C.)

**18787** COMMENTS ON STACKING FAULT ENERGY OF THORIUM. J. O. Stiegler and C. J. McHargue (Oak Ridge National Lab., Tenn.). Acta Met., 11: 225(Mar. 1963).

Transmission electron microscopic studies were made of foils made from cold-rolled thorium sheet. Tangled dislocations forming a crude cell structure were observed, but no fringes characteristic of stacking faults were visible. No example of cross-slip was observed. The results suggest that thorium has an intermediate stacking fault energy. The interpretation of stacking fault probability as deduced from x-ray line shifts is discussed. (D.L.C.)

**18788** ELECTRON MICROSCOPE OBSERVATIONS ON THE PRECIPITATION OF ZIRCONIUM HYDRIDE IN ZIRCONIUM. J. E. Bailey (Central Electricity Generating Board, Berkeley, Glos., Eng.). Acta Met., 11: 267-80(Apr. 1963). (In English)

A study has been made of the precipitation of zirconium hydride in zirconium at hydrogen concentrations in the range 100 to 1000 ppm using the transmission electron microscopy technique. In rapidly cooled or quenched specimens the precipitates appear needle-like with axes lying along $(11\bar{2}0)$ directions and are probably platelets parallel to $\{10\bar{1}0\}$ planes of the matrix. In slowly cooled specimens the precipitates appear comparatively large in two dimensions. Electron and x-ray diffraction experiments show that all precipitates have a face centered tetragonal struc-

ture. Identical orientation relations also appear to hold for all precipitates. The needle-like precipitates grow rapidly along their $(11\bar{2}0)$ type axes apparently remaining coherent; growth in the direction normal to their axes is accompanied by the formation of dislocations and the precipitates become incoherent on the appropriate faces. Beam heating experiments show that nucleation of the hydride does not necessarily require the presence of dislocations but that preferential precipitation will occur on them and on grain boundaries when present. (auth)

**18789** GAMMA RADIATION ABSORPTION CHANGES IN GRAPHITIZED CHARCOAL AS A CONSEQUENCE OF AN APPLIED PRESSURE. J. Bujok and B. Sujak. Acta Phys. Polon., 22: 435-7(Nov. 1962). (In German)

Preliminary measurement results on gamma radiation absorption changes in graphitized charcoal as a consequence of applied pressure are reported. The research apparatus is shown graphically and described. Pressures up to 26.8 $kg/cm^2$ were applied. After the maximum pressure is attained, the charge is released and the measurement series is started again. The results are graphed and show that the second series of measurement points do not coincide with the initial points. This was to be expected as irreversible deformations originating from the pressure applied occur in the interior of the block. (J.S.R.)

**18790** INITIATION AND PROPAGATION OF MICROCRACKS IN CRYSTALS OF ZIRCONIUM–HYDROGEN ALLOYS. D. G. Westlake (Argonne National Lab., Ill.). Am. Soc. Metals, Trans. Quart., 56: 1-10(Mar. 1963). (ANL-FGF-351)

Alpha-zirconium crystals that contained zirconium hydride precipitates showed less ductility than unalloyed crystals in low strain-rate tensile tests. A metallographic study revealed the ductile nature of the metal phase and the interactions of brittle hydride particles and deformation modes, which resulted in the initiation of microcracks. Slow propagation of numerous cracks through the metal phase resulted in reduced load-bearing area and ultimate failure. (auth)

**18791** INFLUENCE OF ARGON AND HYDROGEN ENVIRONMENTS ON THE RATE OF DIFFUSION OF COBALT-60 IN NICKEL. H. E. McCoy, Jr. and J. F. Murdock (Oak Ridge National Lab., Tenn.). Am. Soc. Metals, Trans. Quart., 56: 11-15(Mar. 1963).

Experiments were run to determine whether the influence of environment on the rate of void growth in nickel and nickel-base alloys during creep may be due either to a change in the concentration of vacancies or to a change in their mobility. The experimental approach used was that of studying the rate of diffusion of dilute quantities of $Co^{60}$ in nickel. Pairs of specimens were run under duplicate conditions except for environment, which was argon for one specimen and hydrogen for the other. Subsequent sectioning and counting showed that the rate of diffusion of $Co^{60}$ in nickel is the same whether the environment is argon or hydrogen. This in turn implies that neither the concentration of vacancies nor their mobility is significantly different in the two environments. (auth)

**18792** THE TERNARY ALLOY SYSTEM MOLYBDENUM–RHENIUM–HAFNIUM. A. Taylor, N. J. Doyle, and B. J. Kagle (Westinghouse Electric Corp., Pittsburgh). Am. Soc. Metals, Trans. Quart., 56: 49-67(Mar. 1963).

A rapid survey of the ternary system Mo–Re–Hf showed the phase fields to be extensions of those present in the constituent binaries, and no new ternary intermediate phases were discovered. The bcc $\alpha$-Mo primary solid solution, which extends from Mo to 38 at. % Re and 22 at. % Hf, was found to stretch into the ternary triangle as far as 75Mo–15Re–10Hf. The $\sigma$ phase field, which extends from 50 to 70 at. % Re in the binary system Mo–Re, is incapable of taking large amounts of Hf into solid solution and is confined to an extremely narrow strip along the Mo–Re edge which is less than 1 at. % Hf wide. By comparison, the narrow $\chi$ phases based on $MoRe_3$ and $HfRe_3$ respectively, and which have the $\alpha$-Mn structure, link together and broaden out enormously, attaining the approximate composition 50Mo–35Re–15Hf. Above 2162°C, the $\chi$ phase decomposes peritectoidally to form the hep $\alpha$-Re primary solid solution + $\sigma$ phase. The narrow Laves phase $\eta$ based on $Mo_2Hf$ reaches across the diagram to link up with the narrow $\epsilon_4$–$Re_2Hf$ region, the structure changing from cubic to hexagonal as Re is progressively replaced by Mo. The $Re_2Hf$ phase is succeeded by a narrow tetragonal phase, $\phi$, based on ReHf, the limits of the $\epsilon_4$ and $\phi$ phases defining a three-phase field in conjunction with the extensive bcc terminal solid-solution of $\beta$ Hf, the latter being capable, at low alloying contents, of transforming martensitically into the low-temperature hep $\alpha$-Hf phase. (auth)

**18793** CORRELATION OF THE THERMAL COMPONENT OF THE YIELD STRESS OF THE BCC METALS. H. Conrad and W. Hayes (Aerospace Corp., El Segundo, Calif.). Am. Soc. Metals, Trans. Quart., 56: 125-34(Mar. 1963).

The variation of the thermal component of the yield stress $\tau^*$ with temperature for the Group VA and VIA bcc transition metals was determined from data in the literature. It was found that the temperature dependence of $\tau^*$ is relatively independent of structure for a purity of <99.98%, but may decrease for higher purity material and for single crystals as compared to polycrystals, in agreement with what was previously found for iron. By plotting $\tau^*$ vs the parameter $(T-T_0)/T_m$ it was possible to correlate the data for all the bcc transition metals. T is the test temperature, $T_0$ the temperature where $\tau^*$ is first zero, and $T_m$ the melting temperature. The results support thermally activated overcoming of the Peierls-Nabarro stress as the mechanism responsible for the strong temperature dependence of the yield stress in the bcc metals. (auth)

**18794** THE INVESTIGATION OF STRUCTURAL DISORDER IN MATERIALS BY MEANS OF COLD NEUTRON SCATTERING MEASUREMENTS. D. G. Martin (Atomic Energy Research Establishment, Harwell, Berks., Eng.). Appl. Mater. Res., 1: 160-5(Oct. 1962).

A cold neutron scattering technique is described that should give a better understanding of the behavior of defects in solids. The usefulness and limitations of this technique are discussed. (C.E.S.)

**18795** THE VISUALIZATION OF AN ULTRASONIC EXTINCTION NETWORK IN COARSE GRAINED URANIUM. R. S. Sharpe and S. Aveyard (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Appl. Mater. Res., 1: 170-6(Oct. 1962).

Since the attenuation of ultrasonic pulses is known to vary with metal grain size, methods based on this effect were developed to check that grain refining in uranium fuel rods was effective. An improved method of visually presenting the attenuation data is applied that enables additional information on attenuation variations to be obtained. A fine network of local absorption discontinuities is resolved in those regions of the uranium bars where the grain size is large

and out of specification. It is suggested that this pattern is produced by interaction between the ultrasonic beam and the interfaces of the anisotropic uranium grains when the latter are critically oriented so that they act as opaque barriers. (C.E.S.)

**18796** PREFERRED ORIENTATION AND ANISOTROPY RATIO OF PYROLYTIC GRAPHITE. O. J. Guentert and C. A. Klein (Raytheon Research Div., Waltham, Mass.). Appl. Phys. Letters, 2: 125-7(Apr. 1, 1963).

The preferred orientation index not only characterizes the crystallite alignment in pyrolytic graphites (PG), but provides a straightforward means of investigating the effects of preferred orientation on the anisotropy ratio of bulk properties. Electrical and thermal anisotropies of commonly available PG cannot be considered indicative of ideal structures. (C.E.S.)

**18797** ELECTROKINETIC EFFECTS IN LIQUID MERCURY. A. R. Regel and S. I. Patyanin. At. Energ. (USSR), 14: 122-7(Jan. 1963). (In Russian)

Anomalous conductivity effects were observed in films having thicknesses of the order of the mean free path of the current carrier. This problem was experimentally investigated in the case of Hg, by measuring the electrokinetic mobility of the liquid level in capillaries at room temperature. The mean free path of the conductivity electrons was calculated to be $\lambda = 3.7 \times 10^{-7}$ cm. The value of $(1-\epsilon)$, the portion of the current carrier which is inelastically scattered at the boundary layer, was found to be about $2.1 \times 10^{-2}$. Thus, the results indicate that the system behaves as if only the electrons and vacancies would undergo direct reflection at the boundary. However, it is possible that all the electrons are subject to diffusion-scattering at the boundary ($\epsilon = 0$), but in layers with a thickness of about $3\lambda$ the viscosity of the liquid is sufficiently high to cause a marked reduction of the electrokinetic effect. The temperature and impurities are expected to affect strongly the properties of the boundary layer. (TTT)

**18798** ALLOYS OF THE Nb–Sn SYSTEM WITH EXTREMELY HIGH CRITICAL FIELD STRENGTHS FOR SUPERCONDUCTION. E. Saur (Universität, Giessen, Ger.). Ber. Oberhess. Ges. Natur- Heilk. Giessen, Naturw. Abt., (N.F.) 31: 155-8(1961). (In German)

In Nb–Sn alloys with 50 to 90 at. % Nb, superconduction with discontinuity points appear at 18°K. Measurements of the critical magnetic field at the temperature of liquid hydrogen show extremely high critical field strengths. Typical measurements are shown for alloys with 60, 65, 70, 80, and 85 at. % Nb and for the intermetallic compound $Nb_3Sn$. (J.S.R.)

**18799** REMARKS ON THE DISTRIBUTION OF PORES IN URANIUM DIOXIDE SINTERED UNDER HYDROGEN. Bernard Francois, Roger Delmas, Roger Caillat, and Paul Lacombe (Centre d'Etudes Nucleaires, Grenoble, France). Compt. Rend., 256: 925-6(Jan. 21, 1963). (In French)

The micrographic study of uranium dioxide sintered under hydrogen shows that two conditions are favorable to the localization of residual porosities at the grain boundaries: increase of the specific surface of the uranium dioxide powder sintered and increase of the speed with which the sintering temperature is attained. (tr-auth)

**18800** EVOLUTION OF INTERNAL FRICTION OF AN EXTRA-MILD STEEL TEMPERED AFTER DIFFERENT THERMAL TREATMENTS AT 720°C. Jean-Pierre Villain, Jacques de Fouquet, and Raymond Jacquesson (Laboratoire de Métallurgie Physique, Poitiers, France). Compt. Rend., 256: 942-5(Jan. 21, 1963). (In French)

The variations of the internal friction seem to show that during aging at 720°C surface reactions entraining a progressive decarburization of the samples are produced between the metal and the ambient medium. Aging after tempering depends on the quantity of carbon initially in solution; when it was relatively high, the aging appears to take place in three steps. (tr-auth)

**18801** MEASUREMENT OF ELASTIC CONSTANTS OF MATERIALS BY NON-DESTRUCTIVE TECHNIQUES. DETERMINATION OF THE MODULUS OF ELASTICITY OF GRAPHITE BY MEASUREMENT OF THE RESONANCE OF TRANSVERSE WAVES. José Luis Otero de la Gándara and Rodrigo Méndez Peñalosa. Energia Nucl. (Madrid), 6: 57-68(July-Sept. 1962). (In Spanish)

The equations previously proposed for the measurement of the elastic constants by sonic resonance methods in solids were revised. A method for the control of the elastic properties of graphite using the measurement of the transverse wave frequencies is proposed. The Goens solution of the differential equations of transverse vibration of primatic bars is used. The results obtained with different apparatus are reported. (tr-auth)

**18802** DIFFUSION AND MICRODISTRIBUTION OF CERIUM IN IRON AND CAST IRON. A. P. Lyubchenko and M. V. Mozharov. Fiz. Metal. i Metalloved., 14: 61-7 (July 1962). (In Russian)

Radiometric studies were made of the microdistribution of Ce in cast iron and graphite crystals and in cast iron and Armaco-iron. (R.V.J.)

**18803** SOLUBILITY OF ADMIXTURES IN BERYLLIUM. V. M. Amonenko, V. E. Ivanov, G. F. Tikhinskii, and V. A. Frankel (Inst. of Physics and Tech., Academy of Sciences, Ukrainian SSR). Fiz. Metal. i Metalloved., 14: 128-30 (July 1962). (In Russian)

Thermal expansion of pure Be with small admixtures of C and O was analyzed at up to 1200°C. The c/a ratio for 99.98% purity is 1.547 and for 99% it is 1.567. The maximum solubility of diffused admixtures is 1.0 to 1.5%. (R.V.J.)

**18804** DIFFUSION OF W IN TUNGSTEN, TANTALUM, AND TITANIUM MONOCARBIDES AND IN SOLID SOLUTIONS OF TiC–WC and TiC–WC–TaC. M. L. Baskin, V. I. Tret'yakov, and I. N. Chaporova (All-Union Research Inst. of Hard Alloys, USSR). Fiz. Metal. i Metalloved., 14: 422-7(Sept. 1962). (In Russian)

Parameters and activation energy were determined for W diffusion into TiC, WC, and TaC and in solid solutions of (mole, %) 93% TiC + 7% WC, 77% TiC + 23% WC, 59% TiC + 34% WC + 7% TaC, and 48% TiC + 37% WC + 15% TaC. At 1900 to 2300°C TiC (115 ± 8 kcal/mole) has the lowest activation energy and 50% TiC + 34% WC + 7% TaC (225 ± 27 mole/kcal) the highest; the activation energy of TaC (142 kcal/mole) is close to WC (138 kcal/mole). Additions of TaC to the TiCWC solid solutions increase the activation energy. (R.V.J.)

**18805** URANIUM DIOXIDE AS A NUCLEAR FUEL. Karel Seidl (Inst. of Nuclear Physics, Czechoslovak Academy of Sciences, Řež). Jaderna Energie, 9: 49-58(Feb. 1963). (In Czech)

Uranium dioxide is the most important and the most utilized high-temperature reactor fuel. The properties of this material are presented. The fabrication process and behavior of $UO_2$ during irradiation are discussed. (auth)

**18806** ELECTROLYTIC PREPARATION OF URANIUM WITH THE ELYPOVIST FOR METALLOGRAPHIC INVESTIGATIONS. E. Mueller (Central Inst. for Nuclear Phys-

ics, Rossendorf, Ger.). Jena Rev., 4: 145-7(Aug. 1962). (In English)

From literature references an electrolytic polishing method was selected which in conjunction with epitaxial oxidation of specimens was found to be suitable for representing uranium structures in all occurring stages of treatment. Colored microphotographs are shown. (M.C.G.)

**18807** STRUCTURE AND ORIGIN OF STACKING FAULTS IN EPITAXIAL SILICON. R. H. Finch (Shockley Transistor, Palo Alto, Calif.), H. J. Queisser, G. Thomas, and J. Washburn. J. Appl. Phys., 34: 406-15(Feb. 1963). (UCRL-10351)

Light optical and transmission electron microscopy on epitaxially deposited silicon crystals in [100], [110], and [111] orientation show that growth stacking faults are formed regardless of orientation. These faults occur in bundles of usually tetrahedral figures with the apices at the substrate–film interface, and some faults may exist as closed intrinsic-extrinsic pairs. The results suggest that faults are nucleated by oxygen contamination. Some evidence for impurity segregation to faults is also presented. (auth)

**18808** VAPOR PRESSURE OF LIQUID BISMUTH. A. T. Aldred and J. N. Pratt (Univ. of Birmingham, Eng.). J. Chem. Phys., 38: 1085-7(Mar. 1, 1963).

The vapor pressure of liquid bismuth in the temperature range 800 to 1050°K was measured by the torsion-effusion method. The values obtained are represented by the equation: $\log_{10}p(\text{mm Hg}) = 8.579-(10{,}108/T)$. A few separate Knudsen measurements were performed in the same temperature range and the results used to calculate the molecular weight of bismuth vapor, and thus the heat of dissociation for the reaction $\frac{1}{2}\ Bi_2 \rightarrow Bi$. (auth)

**18809** ELECTRONIC CONFIGURATION AND VALENCY OF URANIUM IN $UCd_{11}$, A MAGNETICALLY DILUTE ALLOY. F. A. Cafasso, H. M. Feder, and D. M. Gruen (Argonne National Lab., Ill.). J. Chem. Phys., 38: 1256(Mar. 1, 1963). (TID-17400; UAC-6889)

The magnetic susceptibilities of $UCd_{11}$ and $NdCd_{11}$ were measured at 2 to 300°K. For $UCd_{11}$, the susceptibility above 4.2°K obeys a Curie-Weiss law $\chi = C/(T + \Delta)$, with $C = 1.798 \pm 0.001$ emu-deg/mole and $\Delta = +41.5$°K. Below 4.2°K, the susceptibility ($39.6 \pm 0.1 \times 10^{-3}$ emu/mole) is nearly independent of temperature. For $NdCd_{11}$, the susceptibility above 7°K obeys a Curie-Weiss law with $C = 1.668 \pm 0.001$ emu-deg/mole and $\Delta = +8$°K. The results indicate the following: Exchange interactions are negligible in both alloys. U has a $5f^3$ configuration and a valence of 4 in $UCd_{11}$. Nd has a $4f^3$ configuration and a valence of 3 in $NdCd_{11}$. (D.L.C.)

**18810** CRYSTAL STRUCTURE, THERMAL EXPANSION AND MELTING POINT OF AMERICIUM METAL. D. B. McWhan, B. B. Cunningham, and J. C. Wallmann (Univ. of California, Berkeley). J. Inorg. Nucl. Chem., 24: 1025-38(Dec. 1962).

The methods for preparing milligram quantities of pure, well-crystallized americium metal are discussed in detail. A versatile high- and low-temperature x-ray powder camera for small radioactive samples is presented. Americium metal prepared by the reduction of americium trifluoride with barium vapor was indexed as hexagonal close-packed with $a = 3.4681 \pm 0.0008$ Å and $c = 11.241 \pm 0.003$ Å at 20°C. The proposed structure type is that of lanthanum metal ($P6_3/mmc$ with metal atoms in 2 (a) 000; 00 $\frac{1}{2}$ and 2 (c) $\frac{1}{3}$, $\frac{2}{3}$, $\frac{1}{4}$; $\frac{2}{3}$, $\frac{1}{3}$, $\frac{3}{4}$). Americium metal condensed on a tantalum wire or quartz fibre from the vapor phase was found to be face-centered cubic ($a = 4.894 \pm 0.005$ Å) with a density similar to the dhcp structure. Evidence for the existence of a face-centered cubic form of americium metal above 600°C is presented. The following physical properties of americium metal were determined: (1) Melting point: 994 ± 7°C; (2) Density (x ray): 13.671 ± 0.005 g/cm$^3$(20°C); (3) Metallic radius (CN 12): 1.730 Å; (4) Coefficient of thermal expansion (20°C): $\alpha_a = 7.5 \pm 0.2 \times 10^{-6}$°C$^{-1}$ and $\alpha_c = 6.2 \pm 0.4 \times 10^{-6}$°C$^{-1}$. (auth)

**18811** THE INFLUENCE OF OXYGEN ON THE YIELD STRENGTH OF TWO ZONE-MELTED NIOBIUM ALLOYS. J. D. W. Rawson and B. B. Argent (Univ. of Sheffield, Eng.). J. Inst. Metals, 91: 223-4(Feb. 1963).

Two binary alloys of Nb containing 4.7 at.% Mo and 5.3 at.% Ta were prepared by argon arc melting the raw materials using a non-consumable niobium electrode. An anodizing technique was used to produce a controlled increase in the oxygen content of the recrystallized alloys. Specimens were strained at a strain rate of $9.2 \times 10^{-5}$/sec at room temperature and $8.3 \times 10^{-5}$/sec at −196°C. Well-defined yield points were produced in specimens from each alloy in tests at room temperature. In tests at −196°C yield points of the type produced at room temperature were found in only two cases. The effect of an increase in oxygen content from 0.01 to 0.1 wt % was to produce an increase in yield strength of approximately $25 \times 10^3$ lb/in$^2$. The increase in strength resulting from a decrease in temperature was greater in the case of the two alloys than for the unalloyed material. (M.C.G.)

**18812** THE CONSTITUTION DIAGRAM OF THE RHENIUM–HAFNIUM SYSTEM. A. Taylor, B. J. Kagle, and N. J. Doyle (Westinghouse Research Labs., Pittsburgh). J. Less-Common Metals, 5: 26-40(Feb. 1963). (In English)

A tentative constitution diagram of the binary alloy system rhenium–hafnium was drawn. The single-phase fields of interest consist of (a) a hexagonal close-packed primary solid solution based on $\alpha$-Re which can retain 3.5 at. % Hf in solid solution at the eutectic temperature of 2930°C, (b) an intermediate $\chi$-phase having the $\alpha$-Mn structure which forms via a peritectic reaction at 3086°C and extends from 10.5 to 17.5 at. % Hf, (c) a narrow intermediate Laves phase $\epsilon$-$Re_2Hf$ having the C14-$MgZn_2$ structure which forms directly from the melt at approximately 3160°C and which extends from 32.5 to 38.0 at. % Hf at the peritectic temperature of 2445°C, (d) a narrow intermediate tetragonal phase ReHf which forms peritectically at 2445°C and approximately 49.5 at. %, extending from 49 to 50 at. % Hf, (e) a wide body-centered cubic terminal solid solution field $\beta$, ranging from 87.5 at. % Hf at the eutectic temperature of 1840°C to 100 at. % Hf above 1950°C, and (f) an extremely narrow hexagonal close-packed phase field denoted by $\alpha$-Hf formed by the martensitic transformation of $\beta$-Hf and extending from ~99.2 to 100 at. % Hf. (auth)

**18813** SYNTHESIS OF THE SYSTEM HAFNIUM–OXYGEN. E. Rudy and P. Stecher (Metallwerk Plansee A. G., Reutte Tirol, Austria). J. Less-Common Metals, 5: 78-89(Feb. 1963). (In German)

Using sintered and arc-melted specimens, the hafnium–oxygen system was investigated by means of x-ray and metallographic methods as well as by melting point determinations. At 1350°C $\alpha$-hafnium dissolves 20.5 at. % oxygen ($a = 3.214$ Å, $c = 5.101$ Å); the solubility range was found to be almost independent of temperature. The following eutectic reactions were established: Melt (8 at. % O) → $\beta$-Hf-Mk (5 at. % O) + $\alpha$-Hf-Mk (11 at. % O), T = 2000 ± 30°C. Melt (29 at. % O) → $\alpha$-Hf-Mk(21 at. % O) + $HfO_{2-x}$(x ~

0.25), T = 2180 ± 40°C. The oxygen-stabilized $\alpha$-modification (21 at. % O) melts congruently at 2300°C. The electrical resistivity of $\alpha$-hafnium increases linearly with the oxygen content ($\rho_0$ = 35.5 $\mu\Omega$/cm, $\rho$ (8 at. % O) = 180 $\mu\Omega$/cm), whereas the course of the hardness in the range from 1 to 20 at. % O can be described fairly accurately by a parabolic equation: HV20 = 270 + 80 $\sqrt{\text{at. \% O}}$. (auth)

**18814** FERROMAGNETIC HALL EFFECT OF GADOLINIUM. A. S. Marotta and K. J. Tauer (Watertown Arsenal, Mass.). J. Phys. Soc. Japan, 18: 310(Feb. 1963).

Measurements on polycrystalline Gd show an unusually large ferromagnetic Hall effect. Experimental results indicate the spin-orbit interaction involved is that of the individual scattering process for the 5d and 6s conduction electrons. (C.E.S.)

**18815** HYPERFINE FIELD IN $ZrFe_2$–$UFe_2$ TERNARY SYSTEM. Shigehiro Komura and Naomoto Shikazono (Japan Atomic Energy Research Inst., Tokyo). J. Phys. Soc. Japan, 18: 323-4(Feb. 1963).

The hyperfine fields in $Zr_{1-x}U_xFe_2$, with x = 0, 0.2, 0.4, 0.6, 0.8, and 1.0, were measured by Mössbauer effect and compared with the results of magnetization measurements. Resonance absorption of nuclear gamma rays of 14.4 kev from $Co^{57}$ was measured as a function of relative velocity between source and absorber for each specimen at liquid nitrogen temperature. The magnitudes for the hyperfine fields of $Zr_{1-x}U_xFe_2$ at liquid nitrogen temperature are plotted as a function of atomic magnetic moment of iron in these compounds at 80°K under the assumption that zirconium and uranium do not have a magnetic moment. (C.E.S.)

**18816** A VERSATILE SILICA DILATOMETER. G. G. Matthews, I. H. R. Satterthwaite, and C. Cameron (C. A. Parsons and Co. Ltd., Newcastle upon Tyne, Eng.). J. Sci. Instr., 40: 42-3(Jan. 1963).

A dilatometer was constructed for making routine measurements of linear thermal expansion coefficients on uranium specimens. The accuracy for 5-cm long specimens is ~1% at temperatures below 100°C. (D.L.C.)

**18817** THE COMPATIBILITY OF CERAMIC FUEL MATERIALS WITH CLADDING MATERIALS AND METALLIC MATRIX ELEMENTS. (SUMMARY REPORT). H. E. Roellig (Zentralinstitut für Kernphysik, Bereich Werkstoffe und Festkorper, Rossendorf, Ger.). Kernenergie, 5: 809-24(Dec. 1962). (In German)

A survey was made on the compatibility of uranium oxides, uranium carbides, and intermetallic uranium compounds with aluminum, zirconium, metals of the iron group, and high-temperature materials. The research methods (sample preparation and annealing) and evaluation methods were described. The results given by various authors were compared and discussed. (tr-auth)

**18818** THE RELATIONSHIP BETWEEN PHYSICAL PROPERTIES AND THE STRUCTURE OF METALS. C. R. Tottle (Victoria Univ., Manchester, Eng.). Mater. Res., 1: 9-16(Apr. 1962).

A few fields are considered in which physical measurements may contribute to the understanding of metals and alloys, not only in basic structure but in improvements in manufacturing quality and better utilization of resources. By utilizing the relation between elastic modulus, specific heat, and thermal expansion, some metals lend themselves to determinations of other physical properties in relation to one measured parameter, where the bulk of the specimen prevents the accurate use of a standard technique. (C.E.S.)

**18819** NEW METHOD OF DETERMINING THE ACTIVATION ENERGIES OF DIFFUSION. APPLICATION TO URANIUM MONOCARBIDE. A. Accary and J. Trouvé (Centre d'Études Nucléaires, Saclay, France). Mem. Sci. Rev. Met., 60: 117-24(Feb. 1963). (In French)

A method of measuring the activation of diffusion is given which is applicable to brittle refractories and based on the continuous measurement of the electrical resistivity of a compressed product of the refractory studied. In the case of the uranium monocarbide, it was possible by the method to determine that the mechanism of sintering during its initial stage involves volume diffusion, and to measure the activation of self-diffusion for this monocarbide. The value 72 ± 6 kcal/mole was confirmed. (auth)

**18820** SELF-DIFFUSION OF ZIRCONIUM IN THE $\beta$-PHASE OF "ZIRCALOY-2." G. B. Fedorov and F. I. Zhomov. Met. i Metalloved. Chistykh Metal., Sb. Nauchn. Rabot, No. 3, 43-5(1961).

Zircaloy-2 was smelted in an arc furnace in a purified argon atmosphere from iodide Zr containing (in wt %): Pb 1.5, Fe 0.12, Cr 0.05, and Ni 0.05. On specimens (9 × 10 × 18 mm) $Zr^{95}$ isotope was applied by spraying in a vacuum. Diffusion annealing was performed in a vacuum at 950 to 1200°C. The diffusion coefficient, D, was determined by laminar integral radiometric analysis. At 950, 1030, 1120, and 1200°C, D values were equal to $0.6 \times 10^{-9}$, $1.7 \times 10^{-9}$, $4 \times 10^{-9}$, and $8.4 \times 10^{-9}$ cm$^2$/sec, respectively. The pre-exponential factor and activation energy of Zr self-diffusion in Zircaloy-2 were $6 \times 10^{-3}$ cm$^2$/sec and 40,000 cal/g-atom, respectively. It was concluded that an increase in activation energy of Zr self-diffusion in Zircaloy-2 as compared with pure Zr, indicates an increased strength of interatomic bond in alloying with Zr. D was lower in the temperature range investigated in Zircaloy-2 than in pure Zr. Diffusion characteristics of Zircaloy-2 almost do not differ from corresponding characteristics of Zr alloy with 1.5% Sn. (Referativnyy Zhurnal, Metallurgiya, No. 8, 1962).

**18821** URANIUM DIFFUSION INTO ZIRCONIUM FROM URANIUM–MOLYBDENUM ALLOYS. G. B. Fedorov and F. I. Zhomov. Met. i Metalloved. Chistykh Metal., Sb. Nauchn. Rabot, No. 3, 193-5(1961).

The diffusion of U in iodide Zr from U–Mo alloys containing 3 and 9% Mo was studied. Diffusion pairs were obtained by wedging U–Mo alloy plates into Zr specimens. The specimens were annealed in evacuated quartz ampoules at 900 to 1050°C for 160 hr. Then thin layers were taken off the contact surface and the integrated $\alpha$ activity of the remaining specimen portion was measured. At 950, 1000, and 1055°C diffusion coefficients of 3% Mo alloys were calculated and found to be equal to $4 \times 10^{-12}$, $1.8 \times 10^{-11}$, and $9 \times 10^{-11}$ cm$^2$/sec, respectively. At 900, 950, 1000, and 1055°C the diffusion coefficients of 9% Mo alloys were equal to $5.6 \times 10^{-12}$, $1.5 \times 10^{-11}$, $5.8 \times 10^{-11}$ and $2.5 \times 10^{-10}$, respectively. The pre-exponential factors for U, 3% Mo and 9% Mo were 0.46, $5.7 \times 10^2$ and $2.8 \times 10^5$ cm$^2$/sec, respectively; the activation energies determined were equal to 47,300, 76,000, and 95,000 cal/g-atom, respectively. It was concluded that the effect of inhibited U diffusion in Zr can manifest itself in the hardening of U during its alloying with Mo rather than as a result of alloying Zr with another element. (Referativnyy Zhurnal, Metallurgiya, No. 8, 1962).

**18822** SOME STRUCTURAL DATA OF METALLIC PHASES. [PART] VIII. K. Schubert, K. Frank, R. Gohle, A. Maldonado, H. G. Meissner, A. Raman, and W. Rossteutscher (Max-Planck-Institut für Metallforschung, Stuttgart). Naturwissenschaften, 50: 41(1963). (In German)

Crystalline parameters are given for the following alloys and systems: V–Pt, Mo–Pt, V–Ni, Nb–Pd, Ti–Zn, Hf–Zn, V–Ga–O, Ta–Ga, V–Ga, Nb–Ga–O, Nb–Ga, Ti–In, Hf–In, Zr–In, Zr–Al–Si, Ti–Al–Si, Ti–Sn, Pt–Al–Si, Pd–Ge, Pd–As, Hf–Sb, Mg–In, and Mg–Ga. (J.S.R.)

**18823** KINETICS OF $\beta$-TO-$\alpha$ MARTENSITIC TRANSFORMATION IN U–Cr ALLOYS. Kō Soeno (Hitachi Ltd., Japan). Nippon Genshiryoku Gakkaishi, 5: 127-33(Feb. 1963). (In Japanese)

The kinetics of $\beta$-to-$\alpha$ martensitic transformation in uranium alloys containing 0.25 to 1.5 at. % Cr were studied. Upon two alloys of U-0.5 at. % Cr and U-0.75 at. % Cr, the rate curves and the amount of the martensitic transformation under isothermal conditions were examined in detail by a dilatometric method. According to the results on these two alloys, it is observed that the isothermal completion of the martensitic transformation is inclined to be difficult in the temperature region of the less extent of the undercooling from $M_s$. However, if the undercooling from $M_s$ is increased, the completion is actually attained when the contraction followed by Johnson-Mehl's rate curve ceases. In general, the martensitic transformation becomes more sluggish with increasing chromium content and it is not detected by a dilatometer in U-1.5 at. % Cr alloy. In U-1.0 at. % Cr alloy, however, the martensitic transformation completes to about 60 to 70% at about 150°C. From the available information obtained on the kinetics of the martensitic transformation, methods for the determination of $M_s$ temperature, especially by means of observing microstructures produced under isothermal conditions, are discussed in detail. (auth)

**18824** NOTE CONCERNING THE MÖSSBAUER STUDY OF THE ORDER-DISORDER TRANSFORMATION IN $Ni_3Mn$. R. S. Krogstad, R. W. Moss, and V. Vali (Boeing Scientific Research Labs., Seattle). Phys. Letters, 4: 44-5(Mar. 1, 1963). (In English)

The Mössbauer study of stoichiometric $Ni_3Mn$ shows that the transformation from the disordered to the ordered state proceeds by the classical first-order nucleation and growth process. Some Ni–Mn alloys are ferromagnetic in the ordered state and weakly ferromagnetic, or paramagnetic, in the disordered state. The difference is most pronounced near the composition $Ni_3Mn$. The samples were partially ordered by annealing in a helium atmosphere at 450°C for 10 days. The spectrum left no doubt as to the transformation process. (C.E.S.)

**18825** PURE NUCLEAR ELECTRIC QUADRUPOLE RESONANCE IN IMPURE COPPER. Alfred G. Redfield (Columbia Univ., New York). Phys. Rev., 130: 589-95(Apr. 15, 1963).

The quadrupole interaction of copper nuclei that are near neighbors of Ag and Zn impurities in metallic copper is measured by means of pure quadrupole resonance, using the field-cycling method in which resonance is detected by subsequent remagnetization and Zeeman resonance of spins far from the impurities. Coupling between spin systems is enhanced by applying two frequencies simultaneously, separated by 20 kc; this is a variant of the phase-reversal method. For Ag solute, resonances are observed ($Cu^{63}$) at 620, 475, 200, and 75 kc, due to first, second, third, and fourth or fifth neighbors, respectively. For Zn a search up to 5 Mc shows resolved resonances only at 1980 and 100 kc, which are tentatively ascribed to second and third neighbors. The anomalously large interaction of near neighbors of Zn is ascribed to virtual excitation of d electrons above the Fermi level by the impurity perturbation. (auth)

**18826** EXPERIMENTS ON THE KAPITZA RESISTANCE. R. C. Johnson and W. A. Little (Stanford Univ., Calif.). Phys. Rev., 130: 596-604(Apr. 15, 1963).

The Kapitza resistances of samples of copper, gold, tungsten, single-crystal lithium fluoride, and single-crystal silicon are measured in the temperature range from 1.25 to 2.10°K. It is found that a clean copper surface prepared by machining under liquid helium exhibits a Kapitza resistance whose magnitude and temperature dependence are considerably greater than a dirty copper surface exhibits. The Kapitza resistances these samples exhibit can be represented by a power law as follows: Au, $8T^{-3}$; LiF, $23T^{-3.75}$; Cu (clean), $19T^{-3.6}$; Si (unetched, 7 dislocations/cm$^2$), $21T^{-3.2}$; Cu (dirty), $7T^{-2.6}$; Si (etched, 7 dislocations/cm$^2$), $35T^{-4.15}$; W, $39T^{-3.5}$; Si (etched, 800 dislocations/cm$^2$), $35T^{-4.15}$ (units are deg $W^{-1}$ cm$^2$). The interfacial surface of the lithium fluoride crystal is a (100) cleavage plane. The interfacial surfaces of the silicon crystals are (111) planes that are ground, polished, and in some cases, etched. These results are considered in relation to theories. The theories fail to predict both the absolute magnitude and temperature dependence of the Kapitza resistances, and the relative magnitude of the resistances for different samples. In addition, no evidence is found in experiments on cleaned copper of the mechanism proposed by Bloch involving the conduction electrons. (auth)

**18827** LOCALIZED MAGNETIC MOMENTS IN METALS. A. J. Freeman (Army Materials Research Agency, Watertown, Mass.). Phys. Rev., 130: 888-9(May 1, 1963).

A simple model is used to obtain information about localized magnetic moments in metals from Mössbauer (or nuclear magnetic resonance) experiments. The formulation emphasizes the explicit dependence of the hyperfine field on the spin S′ of the Fe atom and shows why the temperature dependence of the hyperfine field follows a Brillouin function of the total localized spin S (with $S \neq S'$). The moment of Fe atoms in dilute concentrations of Pd, Rh, and Mo are determined and the apparent contradiction between Mössbauer and susceptibility measurements for Rh and Mo is discussed. (auth)

**18828** ORDER-DISORDER EVENTS PRODUCED BY SINGLE VACANCY MIGRATION. J. R. Beeler, Jr. and J. A. Delaney (General Electric Co., Cincinnati). Phys. Rev., 130: 962-71(May 1, 1963).

Monte Carlo computational experiments, based on the Finn-McManus method, were used to study the interaction between ordering (disordering) and single vacancy migration in AB alloys. Square planar, simple cubic, and bcc lattices were studied. If the alloy is initially disordered (short-range order near zero), the extent of vacancy migration for N jumps is slightly larger than that for a symmetric random walk. However, when the initial short-range order is either comparable to or larger than the equilibrium value for the critical temperature, the ordering process contracts the extent of vacancy migration relative to that for a symmetric random walk. In two dimensions (surface diffusion) the degree of contraction depends upon the number of jumps and is larger than that for three dimensions (bulk diffusion), which is independent of the number of jumps. The long- and short-range order established in expanding migration regions by $10^4$ to $3 \times 10^4$ vacancy jumps are very close to the values predicted by Bethe's model for the equilibrium state. A system of contiguous antiphase domains was formed in an initially disordered alloy, by single vacancy migration, rather than a single ordered nucleus. (auth)

**18829** GIANT THERMAL EXPANSION COEFFICIENTS IN RARE EARTH METALS AT LOW TEMPERATURES. K. Andres (Eidgenössische Technische Hochschule, Zurich). Phys. Rev. Letters, 10: 223-5(Mar. 15, 1963).

The thermal expansion of lanthanum, cerium, neodymium, gadolinium, and ytterbium from 1.5 to 14°K were measured. Large negative values of the linear thermal expansion coefficient, $\alpha$, were observed for polycrystalline samples of Ce and Nd below the temperatures of their first specific-heat maxima at 12.5 and 7°K, respectively. For La $\alpha$ shows a normal temperature dependence above its critical temperature of 5.9°K. Yb has a normal behavior apart from a small anomaly around 2.3°K. Gd shows an anomalous behavior in its polycrystalline form, in that $\alpha$ changes sign twice below 12°K. The particular anomalies are discussed. (C.E.S.)

**18830** SUPERCONDUCTIVITY IN TRANSITION METALS. Jun Kondo (Tokyo Univ.). Progr. Theoret. Phys. (Kyoto), 29: 1-9(Jan. 1963). (In English)

A two-band model of superconductivity is investigated. One band is treated in line with Bardeen-Cooper-Schrieffer (BCS) (the cut of the interaction outside $\hbar\omega$ of the Fermi energy). In the other band the interaction is assumed to be repulsive. The superconducting transition temperature is always raised over that of the single attractive band, when an interaction between the bands is introduced. The increase of the temperature is large when the density of states of the repulsive band at the Fermi surface is large. The isotope effect vanishes when the interband interaction is large. This model can account for the superconducting properties of the $V_3M$ series and $Nb_3Sn$. It is argued that superconducting non-transition metals belong to single-band superconductors, whereas the superconductivity of transition metals is largely due to their overlapping bands, especially in lanthanum. (auth)

**18831** ON PERSISTENT CURRENTS IN A SUPERCONDUCTING ALLOY. [PART] I. Kazumi Maki (Kyoto Univ.). Progr. Theoret. Phys. (Kyoto), 29: 10-22(Jan. 1963). (In English)

A mean free path effect of impurities on a uniform flow in a superconducting alloy is investigated. The change in the energy gap for a small current is given. The critical current is determined from the "de-pairing" condition. It is shown that the critical current vanishes as $(l/\xi_0)^{1/2}$, when $l$ tends to zero, where $l$ is the mean free path and $\xi_0$ is the correlation length of the electron pairs. (auth)

**18832** YTTERBIUM: EFFECT OF PRESSURE AND TEMPERATURE ON RESISTANCE. R. A. Stager and H. G. Drickamer (Univ. of Illinois, Urbana). Science, 139: 1284 (Mar. 29, 1963).

The electrical resistance of Yb, measured as a function of pressure, shows a sharp maximum at 38 kb, both at 300 and 77°K. At low pressures Yb is a metal because of overlap between filled and empty bands. From about 20 kb to the resistance maximum it is a semiconductor, indicating that the overlap disappears. At the maximum there is a phase transition, and beyond this pressure Yb is again metallic. (auth)

**18833** INDIUM ANTIMONIDE: SUPERCONDUCTIVITY OF THE METALLIC FORM. H. E. Boemmel, A. J. Darnell, W. F. Libby, and B. R. Tittmann (Univ. of California, Los Angeles). Science, 139: 1301-2(Mar. 29, 1963).

The transition of metallic indium antimonide into the superconducting state begins at 2.1°K and is complete at about 1.6°K. The data are close to those for white tin. (auth)

**18834** CRYSTAL STRUCTURES OF TITANIUM, ZIRCONIUM, AND HAFNIUM AT HIGH PRESSURES. John C. Jamieson (Univ. of Chicago). Science, 140: 72-3(Apr. 5, 1963).

At high pressures, as determined by x-ray analysis, titanium and zirconium metal have a distorted, body-centered-cubic structure. This phase persists on pressure release. The normal hexagonal close-packed structures are recovered when the metals are heated. An electronic shift must occur in the transition. Hafnium metal showed no such transition. (auth)

**18835** ANODIC PROCESSES DURING NIOBIUM DISSOLVING IN CHLORIDE AND CHLORIDE-FLUORIDE MELTS. L. E. Ivanovskii and M. T. Krasil'nikov. Tr. Inst. Elektrokhim., Akad. Nauk SSSR, Ural'sk Filial, No. 2, 79-83(1961).

The dependence of current efficiency in anodic Nb dissolving upon the current density, D, and the composition of the bath was investigated. An equimolar mixture of K and Na chlorides was used as an electrolyte. The temperature was maintained at 700 ± 10°C. It was established that the mean valence of Nb ions passing into the melt increased with higher D. At relatively low $D_a$, (about 0.01 amp/cm$^2$) dissolving is accompanied by the formation of $Nb^{2+}$ and $Nb^{3+}$; at $D_a > 0.1$ amp/cm$^2$ $Nb^{4+}$ ions appear in the melt, and at high D $Nb^{5+}$ ions appear. In a second series of experiments, polarization of the Nb anode was measured at D = $10^{-3}$ – 5 amp/cm$^2$, various temperatures, and different composition of the bath. It is shown that in chloride melts the dependence of the anode potential upon D is linear and is described by equation $\varphi = a + b \log i$ in a wide D range. Polarization increases with higher D in chloride–fluoride melts. (Referativnyy Zhurnal, Metallurgiya, No. 8, 1962).

**18836** INVESTIGATING OXIDE SINTERING BY THE ELECTRIC-CONDUCTIVITY METHOD. S. F. Pal'guev, L. D. Yushina, and Yu. M. Ovchinnikov. Tr. Inst. Elektrokhim., Akad. Nauk SSSR, Ural'sk Filial, No. 2, 193-7 (1961).

Sintering of $CeO_2$ with admixtures of BeO (5 mole %), MgO (10 mole %), CaO (15 mole %), and SrO (9 mole %) was studied. Changes in the electric resistivity were determined as functions of the composition, time of holding, and sintering temperature. Electric resistivity versus sintering time curves were plotted. The electric resistivity of the specimens (solid solutions) increased in the sintering process. Sintering was conducted in a Silit furnace at 1200, 1350, 1450, and 1550°C for 1 to 15 hours. Linear shrinkage values of the specimens are in agreement with changes in the electric resistivity. It was established that at 1200 to 1350°C $CeO_2$ + SrO mixtures are most rapidly sintered, and $CeO_2$ + BeO mixtures at 1450 to 1550°C. The relative sintering rate of mixtures with additions of CaO and MgO was approximately the same at all temperatures investigated. It is shown that the measurement of electric resistivity can be used as a sensitive method for investigating sintering of oxide ceramic specimens. Hypotheses to explain the mechanism of the (diffusion) process are given. (P.C.H.)

**18837** TECHNOLOGY OF NUCLEAR FUELS. Manfred Becker (Nuklear-Chemie und Metallurgie GmbH, Wolfgang, Ger.). VDI (Ver. Deut. Ing.) Z., 105: 170-1(Feb. 1, 1963). (In German)

The development and properties of various fuel materials are described. Those covered include uranium dioxide, uranium carbide, coated-particle fuels, plutonium, and uranium. (M.C.G.)

**18838** THE SYNTHESIS OF WELL DEFINED OXIDES OF URANIUM. B. S. Brčič, J. Rozman, and J. Skerjanc (Univ. of Ljubljana, Yugoslavia). Vestn. Sloven. Kem. Drustva, 6: 9-15(1959). (In Slovenian)

$UO_2$ was prepared from uranyl nitrate, $U_3O_8$, $UF_4$, and ammonium diuranate and its behavior on heating to 900°C was studied. In the same way $UO_2$ was also studied with additions of Ti, Zr, and Th oxides. The ratios of O/U were determined. Beads were pressed from the oxide and sintered at 1250°C. The density (determined pycnometrically with Hg) of the sintered beads and the O/U ratios were determined. The best results were obtained with a mixture of $UO_2$ and $ThO_2$ at 100 to 1. (tr-auth)

**18839** RESULTING APPEARANCE OF THE GLOWING OF SOME AUSTENITIC ALLOYS IN CARBURIZING GASES. Harald Pfeiffer and Georg Sommer (Laboratorium der Vacuumschmelze A. G., Hanau, Ger.). Z. Elektrochem., 66: 671-4(Oct. 1962). (In German)

The behavior of nickel–chromium and nickel–chromium–iron alloys at high temperatures in gas mixtures consisting of carbon monoxide and hydrogen is reported. Under the experimental conditions chosen a melting point depression, caused by the absorption of carbon, of nearly 200°C was observed. Also, attention was drawn to the importance of the spectral emissive power for pyrometric temperature measurements and the dependence of the emissive power on the surface condition of the material under examination. In incandescent atmospheres with a very low concentration of oxidizing gases the difference between the true and the pyrometrically measured black temperature is especially high; in this case the difference amounts to more than 100°C. (auth)

**18840** CHEMISORPTION AND RESISTANCE CHANGES IN VAPOR-DEPOSITED ZIRCONIUM FILMS. N. Hansen (Philips Zentrallaboratorium GmbH, Aachen). Z. Elektrochem., 66: 726-31(Oct. 1962). (In German)

The surface of zirconium films, obtained by vapor condensation in an ultrahigh vacuum, was measured and the kinetics as well as the changes in the electric resistance during the adsorption of carbon monoxide were investigated. Different mechanisms of chemisorption occurred. They differed in kinetics and in the relative changes in electric resistance. These changes can be explained by a compound formation with a certain number of surface atoms of the metal. This was associated with a decrease in the effective thickness of the layer. (auth)

**18841** THE PHASE RELATIONS IN URANIUM–ALUMINUM–IRON ALLOYS OF THE RANGE PORTION URANIUM–$UAl_2$–$UFe_2$. Guenter Petzow and Raghav Tank (Max-Planck-Institut für Metallforschung, Stuttgart). Z. Metallk., 54: 91-8(Feb. 1963). (In German)

An investigation was made of the ternary system uranium-aluminum-iron. The phase relations were determined in the uranium-rich portion up to the quasibinary section $UFe_2$-$UAl_2$. The results are based on investigations by thermoanalysis, chemical and x-ray methods, and microscopy. Typical for the system in the solid state are the extended three phase equilibria. Uranium solid solutions show a limited ternary solubility, but not the intermetallic compounds $UAl_2$, $U(Fe,Al)_2$, $UFe_2$, $U_6Fe$. (auth)

**18842** ON DIFFUSION IN THE SYSTEM COPPER–BERYLLIUM. Rudolf Reinbach and Felicitas Krietsch (Laboratorium der Vacuumschmelze A. G., Hanau, Ger.). Z. Metallk., 54: 173-9(Mar. 1963). (In German)

In the inter-diffusion of copper and beryllium all possible phases of the system are formed. Their growth is proportional to the square root of the time. The diffusion coefficients for the $\beta$ and $\gamma$ phases that are close to the contact interface are higher than those of the neighboring phases; however, the activation energies Q are lower in $\beta$ and $\gamma$. The diffusion constant $D_0$ shows a continuous decrease from the copper-rich to the beryllium-rich phases. There is not much difference between the partial diffusion coefficients of copper and beryllium. The value for beryllium is only slightly higher. (auth)

**18843** THE EFFECT OF OVERALL PRESSURE ON THE SUPERCONDUCTING TRANSITION TEMPERATURE OF $Nb_3Sn$. B. G. Lazarev, L. S. Lazareva, O. N. Ovcharenko, and A. A. Matsakova (Inst. of Physics and Tech., Academy of Sciences, Ukrainian SSR). Zh. Eksperim. i Teor. Fiz., 43: 2309-10(Dec. 1962). (In Russian)

It was previously discovered that there is no evidence of an isotopic effect on the superconducting transition temperature, $T_c$, for isotopes of ruthenium 99 to 104, and that there is a small isotopic effect in $Nb_3Sn$ in which $T_c$ does not change as $1/\sqrt{M}$ as is demanded by the mechanism of the electron-phonon interaction but rather as $M^{-1/4}$. A study was made of the effect of pressure on $T_c$ for $Nb_3Sn$. A pressure of 1730 kg/cm$^2$ was applied to a system containing a specially prepared sample of $Nb_3Sn$. The change in $T_c$ at this pressure was 0.045°K, that is $dT_c/dp = -2.5 \times 10^{-5}$ °K/atmosphere. This result is compared with those of such good superconductors as tin and mercury where $dT_c/dp = -4.6 \times 10^{-5}$ and $-3.6 \times 10^{-5}$ °K/atmosphere, respectively. In all three cases, the change in $T_c$ approaches the proportionality $1/\sqrt{M}$ as is required by the mechanism of the electron-phonon interaction. It was also determined that the variation of the magnetic field strength $(dH_c/dt)T_c = 15{,}500$ kilogauss/degree, a value which is in good agreement with the data of Kunzler. The coefficient of thermal expansion ($\Delta a$) and of specific heat ($\Delta C$) in the transition calculated by well-known thermodynamic expressions give extremely exaggerated values ($\Delta a \approx 5 \times 10^{-4}$/degree, $\Delta C \approx 100$ cal/degree), thus indicating that the values of $dH_c/dT$ and $dT_c/dp$ are related only in a very low degree with the volume of $Nb_3Sn$. These results also correspond with the measurements of other properties of this superconductor, confirming that $Nb_3Sn$ and similar superconductors retain the property of superconductivity in magnetic fields of very great intensity. (TTT)

**18844** DIFFERENCES IN THE EFFECT OF ADMIXTURES AND OF PLASTIC DEFORMATION ON THE TEMPERATURE OF SUPERCONDUCTING TRANSITION OF METALS. B. G. Lazarev, L. S. Lazareva, and V. I. Makarov (Inst. of Physics and Tech., Academy of Sciences, Ukrainian SSR). Zh. Eksperim. i Teor. Fiz., 43: 2311-12 (Dec. 1962). (In Russian)

In previous reports on studies concerning the effect of impurities in reducing the superconducting transition temperature, $T_c$, of a number of metals, the effect was ascribed to a decrease in the mean free path of the conductance electrons from which it was concluded that distortion of the lattice and deformation of the metal produce a lowering of $T_c$. In order to test this point, the change in $T_c$, at the temperature of liquid helium, was evaluated by measuring the resistance ratios of samples of tin containing up to 0.5% Sb both in the annealed and deformed states. The results of this investigation confirm very closely the results of the effect of impurities on the $T_c$ of tin in the annealed state in that the temperature of superconducting transition is reduced in a regular manner. It was observed, however, that distortion of the metal leads to an opposite effect, an in-

crease in $T_c$ and, in fact, up to the maximum concentration of impurity which was studied, the increase in $T_c$ reaches a constant value $\Delta T_c = 0.020$ °K. The observed rise in the transition temperature is claimed to be associated with the fact that plastic deformation of a metal lowers the Debye temperature, that is, reduces the elastic properties of the metal, thus leading to an increase in the electron-phonon interaction and a subsequent rise in $T_c$. (TTT)

**18845** THE JUMP OF THE COEFFICIENT OF THERMAL EXPANSION OF $Nb_3Sn$ AT THE SUPERCONDUCTING TRANSITION TEMPERATURE. B. G. Lazarev, L. S. Lazareva, A. I. Sudovtsov, and F. Yu. Aliev (Inst. of Physics and Tech., Academy of Sciences, Ukrainian SSR). Zh. Eksperim. i Teor. Fiz., 43: 2312-13(Dec. 1962). (In Russian)

A sensitive method previously developed for measurement of the abrupt change in the coefficient of expansion on passing through the superconducting transition temperature, $T_c$, of lead and tin was applied in making similar measurements of $Nb_3Sn$. In previous work it was shown that measurements of coefficients $\Delta V/V \leq 10^{-8}$ could be made with a satisfactory degree of precision. The sensitive element of the device used in making this measurement is a bimetallic strip, coiled in a spiral, one end of which is fixed while the other end turns in relation to the volume change of one metal relative to the other. The degree of turning is utilized as a means of establishing the volume change of $Nb_3Sn$ in passing through the superconducting transition. The spiral measures 55cm in length, with Nb ~ 0.26 in thickness on which a layer of $Nb_3Sn$ ~ 0.05mm thick was placed by diffusion. A curve is shown which depicts the fact that the coefficients of expansion as measured by the turning of the spiral exhibits an abrupt change at 18°K, the $T_c$ for $Nb_3Sn$. The slope of the curve (that is the difference of the coefficients of expansion) beyond $T_c$, between 19 to 20°K, is greater than the slope of the curve below $T_c$, between 17 to 14°K. The increase of the coefficient of expansion is found to be $1.5 \times 10^{-7}$ per degree. This value compares favorably with previous measurements by this and other methods on tin and lead. This device was used in measuring the coefficients of expansion and compressibility of $Nb_3Sn$ and Nb in the temperature region from 2 to 300°K. In this region, it was found that the coefficient of expansion of $Nb_3Sn$ is not significantly less than $3 \times 10^{-6}$ at 300°K and $2 \times 10^{-7}$ at 2.4°K. The thermal properties of $Nb_3Sn$ and Nb are very close. As a consequence of these and other factors, such as the Debye temperatures, it is clear that the elastic constants also bear a similar relationship. (TTT)

**18846** CRITICAL FIELDS OF CRYSTALLINE MODIFICATIONS OF Bi-II AND Bi-III. N. B. Brandt and N. I. Ginzburg (Moscow State Univ.). Zh. Eksperim. i Teor. Fiz., 44: 478-80(Feb. 1963). (In Russian)

The critical fields of the modifications Bi-II and Bi-III are investigated. It is found that Bi-II is a soft superconductor with a critical field curve similar to that for tin and Bi-III is a hard superconductor with $(\partial H_c/\partial T)_{T_c} \approx 2600$ Oe/degree. (auth)

**18847** SOME FEATURES OF THE BEHAVIOR OF THE SUPERCONDUCTION TEMPERATURE TRANSITION IN THALLIUM UNDER HIGH PRESSURE. B. G. Lazarev, L. S. Lazareva, and V. I. Makarov (Inst. of Physics and Tech., Ukrainian SSR). Zh. Eksperim. i Teor. Fiz., 44: 481-2(Feb. 1963). (In Russian)

The shift of the superconduction transition temperature in annealed single crystals of pure thallium ($R_{4.2°K}/R_K \sim 2 \cdot 10^{-4}$) is measured in detail at various pressures up to 1730 kg/cm$^2$. A complex dependence of $\Delta T_K$ on $\rho$ is found in this pressure range. The effect of small electron groups is estimated by taking into account the difference of the electron-phonon interaction constant. (auth)

**18848** INVESTIGATION OF Mg–Nd–Mn ALLOYS IN THE REGION CLOSE TO THE MAGNESIUM CORNER. M. E. Drits, Z. A. Sviderskaya, and L. L. Rokhlin. Zh. Neorgan. Khim., 7: 2771-7(Dec. 1962). (In Russian)

Only two phases, Mn and $Mg_9Nd$, are found in Mg–Mn–Nd alloys in equilibrium with the magnesium-base solid solution. A nonvariant transformation iron + Mn $\rightleftharpoons$ $\alpha$ + $Mg_9Nd$ takes place in the magnesium corner at 559.6°C. The presence of hydrogen affects the neodymium content in the annealed solid solutions. (R.V.J.)

**18849** THE URANIUM–CARBON AND PLUTONIUM–CARBON SYSTEMS. A THERMOCHEMICAL ASSESSMENT. A Report from a Panel held in Vienna, October 8-12, 1962. (International Atomic Energy Agency, Vienna). 1963. 48p. $1.00; Sch 21; 6s. std; NF 4; DM 3.20 (IAEA) (STI/DOC/10/14)

Thermodynamic data reported by various laboratories on U–C and Pu–C systems are reported. Efforts were made to resolve various discrepancies. Sections are included on preparation of uranium carbides, phase diagrams, heat capacities and thermal properties of the actinide carbides, heat of formation of the uranium carbides, vaporization studies, high-temperature equilibrium measurements, and the Pu–C system. (J.R.D.)

## Radiation Effects

*Refer also to abstracts 17645, 18362, 18363, 18364, 18365, 18366, 18367, and 18368.*

**18850** (AAEC/TM-183) GAMMA ACTIVITIES IN IRRADIATED BERYLLIUM OXIDE. R. M. Green (Australia. Atomic Energy Commission Research Establishment, Lucas Heights, New South Wales). Mar. 1963. 6p.

The major long-lived activity induced in irradiated Pechiney and Brush BeO specimens is from $Sc^{46}$ arising from Sc present to the extent of about 1 ppm. The Brush specimens showed additional activities from $Fe^{59}$ and $Co^{60}$ and to $Cr^{51}$. The levels of $Cr^{51}$ found are considerably higher than would be expected on the basis of stated Cr impurity levels suggesting that the Cr introduced during handling of the samples on site. Approximate values of the dose-rate are included. (auth)

**18851** (ASD-TDR-62-530) BASES OF NEUTRON DAMAGE MONITORING. Leonard Solon, Raphael Aronson, Francis Clark, and Martin Kelly (TRG, Inc., Syosset, N. Y.). May 1962. Contract AF33(616)-7902. 74p. (AD-283983)

The problems of monitoring and repotting neutron damage effects were reviewed. The commonly used monitors and the analyses generally associated with them are discussed in relation to the problems of damage. Areas requiring further development or revision of technique are indicated. Three analytical procedures are described, each suitable in different situations dependent upon the sample under consideration, the detectors, and the control fluxes available. Results of monitoring damage to structural steel were examined to learn what they imply about the state of damage monitoring and analysis. (auth)

**18852** (BNL-6249) THE MECHANICAL PROPERTIES OF IRRADIATED IRON AND IRON ALLOYS. J. G. Y. Chow, S. B. McRickard, and D. H. Gurinsky (Brookhaven

National Lab., Upton, N. Y.). [1962]. Contract [AT(30-2)-Gen-16]. 56p.

The effects of fast neutron irradiation on the yielding, plastic flow, and fracture properties of pure iron: iron alloyed with carbon, and iron alloyed with chromium were studied as part of an investigation of irradiation damage in bcc metals. In addition, two documented steels, A212B and Mod HY80, were also analyzed. In the pure iron, the $K_y$ term in the relation correlating yield stress with grain size, namely $\sigma_{ys} = \sigma_i + K_y d^{-\frac{1}{2}}$, was reduced to zero by irradiation. Instead, the post irradiation yield stress was inversely proportional to the log 1/T. Further, an exposure of $2 \times 18^{18}$ nvt or greater produced a sharp ductile to brittle transition point with a shift of 85°K in pure iron. This same exposure level also had the effect of producing a linear true stress-true strain curve similar to that obtained from prestrained iron with the apparent elimination of the initial rapid work hardening portion of the curve. The effect of carbon additions up to 0.11 wt.% was to increase the yield strength and decrease the ductility before irradiation. However, the post irradiation mechanical properties regardless of the carbon content were approximately the same as those of pure iron. The linear variation of yield strength with the log 1/T was not followed by the irradiated carbon alloys. The addition of chromium decreased the yield strength and increased the ductility of both unirradiated and irradiated iron. The linear true stress-true strain curve was obtained and the yield stress varied with the log 1/T after the $2 \times 10^{18}$ nvt exposure. No sharp ductile to brittle transition point was observed. The two steels generally showed increased strength and some decrease in ductility without a sharp ductile to brittle transition point after irradiation. These results are explained by attributing the initial increases in strength and decreases in ductility to radiation produced point defects. After a certain level of exposure was reached, these defects became saturated and vacancy loops were created which tangle with slip dislocations. These tangles create a dislocation cell structure similar to that found in cold worked metals. This structure resulted in the independence of yield strength on grain size and a linear flow curve in irradiated iron. Carbon atoms annihilated some of the vacancies requiring higher exposures for saturation to be reached while chromium was thought to tie up the carbon atoms in carbides facilitating the process. Similarly, the additional elements in the steels were thought in some way to impede the development of the radioinduced cell structure. (auth)

**18853** (BNL-6842) DYNAMICS OF LOW-ENERGY RADIATION DAMAGE PROCESSES IN A BODY-CENTERED CUBIC LATTICE SIMULATING $\alpha$-IRON. Cavid Erginsoy (Brookhaven National Lab., Upton, N. Y.). [1962]. Contract [AT(30-2)-Gen-16]. 36p.

The mathematical simulation of the motion of a large number of interacting atoms in a lattice, by means of a large capacity digital computer, was used to determine the dynamic features of the displacement and collision processes resulting from radiation damage to a body-centered cubic lattice simulating $\alpha$-Fe. The following conclusions were reached for the present calculation on the $\alpha$-Fe model: the key mechanism of displacement at low energies is a dynamic replacement by the knock-on which is accomplished by an extended chain of replacements and the interstitial is formed several distances from the vacancy; the stable effect appears to be a (110)-oriented split interstitial in two different types of potential used; the replacement chains propagate with shock wave velocities, the (111) being the direction in which the loss of energy is least and the range greatest; the threshold energy for displacing an atom is highly dependent on direction and the easiest displacement is the (100) in the bcc lattice; as a result of the directional dependence of the threshold energy, the integrated probability of displacement is a slowly rising function of knock-on energy; and the damage at knock-on energies lower than 35 ev is entirely due to the formation of defects by (100) replacement chains and the damage rate is considerably lower than at higher energies. (H.G.G.)

**18854** (CRFD-1117) ZIRCALOY SHEATHED $UO_2$ FUEL ELEMENTS IRRADIATED AT VALUES OF $\int kd\theta$ BETWEEN 40 AND 83 W/cm. M. J. F. Notley, A. S. Bain, S. Ananthakrishnan, and G. W. Parry (Atomic Energy of Canada Ltd., Chalk River, Ont.). Dec. 1962. 57p. (AECL-1676)

The irradiation of eight Zircaloy-2-clad $UO_2$ fuel elements at heat ratings of $\int kd\theta$ between 40 and 83 w/cm is described. The charge was irradiated for 16.7 equivalent full power days. Observations and conclusions concerning the tests are included. (J.R.D.)

**18855** (HW-SA-2229) EFFECTS OF PLASTICIZERS ON RESISTANCE OF POLYVINYL CHLORIDE TO GAMMA IRRADIATION. R. Harrington, L. Boleraski, and S. A. Parks (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). [1958]. Contract [AT(45-1)-1350]. 9p.

Polyvinyl chloride compounds containing tricresyl phosphate (I), dioctyl phthalate (II), 1,3-butenedioladipic acid polyester (III), 2,2-dimethyl-1,3-propanedioladipic acid polyester (IV), butyl benzyl phthalate (V), and epoxidized triglyceride plasticizer (VI) were gamma-irradiated to $10^8$ r exposure. It was found that compound (I) changed 1% or less in hardness. The dielectric constant and loss largest of compounds II, IV, and VI showed the smallest changes measured at 1000 cps. The least change in d-c resistivity was in compound (IV). (auth)

**18856** (IDO-28600) HIGH-TEMPERATURE IRRADIATION OF $UO_2$-BeO BODIES. G. W. Titus (Aerojet-General Nucleonics, San Ramon, Calif.) and J. H. Saling (Battelle Memorial Inst., Columbus, Ohio). Jan. 1963. Contract AT(10-1)-880. 46p.

As a part of the ML-1 reactor fuel evaluation program, $UO_2$-BeO bodies containing two $UO_2$ compositions, 70 and 80 wt % $UO_2$, were irradiated to a burnup equivalent to 8750 hours of ML-1 reactor operation (8.5% $U^{235}$). It was estimated that maximum cladding surface temperatures of 1710°F were attained during irradiation. Reference design burnup for the ML-1 is 9.7% $U^{235}$, in 10,000 hours of operation at maximum clad surface temperatures of 1750°F. Postirradiation examination of the test specimens revealed that the cladding of one of the 80 wt % $UO_2$-BeO specimens had ruptured after severe swelling. All other specimens showed little external effect from the irradiation. Fission gas release from the fuel varied between 0.59 and 2.7% except for the failed specimen which released about 69%. Considerable change was observed in the microstructure of the irradiated specimens although subsequent x-ray diffraction examination did not indicate serious damage to the crystal structure of either the BeO or $UO_2$. The data obtained from this experiment are in substantial agreement with that determined in irradiation experiments performed at other facilities. The performance of 70 wt % $UO_2$-BeO was considered to be suitable for use in the ML-1 reactor. (auth)

**18857** (KAPL-2226) ANNEALING OF NEUTRON RADIATION DAMAGE IN p-TYPE PbTe. J. C. Corelli and D. M. Amorosi (Knolls Atomic Power Lab., Schenectady, N. Y.). Jan. 1962. Contract W-31-109-eng-52. 36p.

The measurement of conductivity, Seebeck, and Hall coefficient changes in p-type PbTe caused by reactor irradiation was extended in a specimen to a reaction-radiation dose of $4.4 \times 10^{19}$ neutrons/cm$^2$ with energy greater than 1 Mev and a thermal-neutron dose of $1.5 \times 10^{21}$ neutrons/cm$^2$. Sample temperature during irradiation was 60 ± 20°C. Permanent changes caused by thermal-neutron transmutations were negligible (< 3 percent), indicating that all the damage is annealable and caused by fast neutron-induced defects. Based on previous irradiation test results and those which follow, a phenomenological model which predicts the behavior of n- and p-type PbTe at possible operating temperatures during reactor irradiation is presented. The carrier-concentration decrease caused by irradiation of the specimen was a factor of 5.3 less than the pretest measurement. This factor accounts for most of the increase in Seebeck coefficient (factor 2.9). Analysis of the annealing effects on electrical conductivity (decreased by a factor 7.6) yields an activation energy for defect migration of ≈ 0.55 ev. Isothermal annealing experiments indicate the simultaneous recovery of conductivity, Hall, and Seebeck coefficients for temperatures in the range 88 to 162°C. (auth)

**18858** (NAA-SR-Memo-8033) IRRADIATION CAPSULES FOR ACCELERATED BURNUP TESTS OF HYPOSTOICHIOMETRIC URANIUM MONOCARBIDE. T. E. Redding (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Dec. 14, 1962. Contract [AT(11-1)-Gen-8]. 65p.

A description of the hydraulic, thermal, nuclear, and structural characteristics of the NAA 74 irradiation capsules which are scheduled for irradiation in the MTR is presented. These assemblies are designed to provide high-burnup and high-temperature irradiation stability data on hypostoichiometric UC. (J.R.D.)

**18859** (NASA-TN-D-1662) THERMOLUMINESCENT SPECTRA OF SODIUM CHLORIDE AND HYDROXIDE-FREE SODIUM CHLORIDE IRRADIATED WITH 40-Mev ALPHA PARTICLES. James A. Partridge (National Aeronautics and Space Administration. Lewis Research Center, Cleveland). Apr. 1963. 15p.

The thermoluminescent spectra of 40-Mev alpha-irradiated as-received and OH-free NaCl single crystals were investigated through postirradiation measurements. Graphs of the variation of emission band intensity and position as a function of temperature for various radiation fluxes are presented. Emission bands at 360 and 432 mμ were found in both crystal types; a new band at 572 mμ is also observed in the OH-free crystals. The 432-mμ band is suppressed in the high-temperature glows of the OH-free crystals. In contrast to x-ray-induced spectra the effect of particle irradiation is to cause the 360- and 432-mμ bands to appear together in the high-temperature glow peaks. Comparison of the glow curves of the two crystal types indicates that the OH-free NaCl has increased light output. An impurity or defect is thought to be responsible for the effects noted in the OH-free crystals. (auth)

**18860** (ORNL-3403) THE EFFECT OF IRRADIATION ON THE HYDROLYSIS OF URANIUM CARBIDES. I. PREPARATION OF URANIUM MONOCARBIDE PELLETS FOR IRRADIATION. M. J. Bradley, L. M. Ferris, T. Hikido, and J. W. Ullmann (Oak Ridge National Lab., Tenn.). Apr. 2, 1963. Contract W-7405-eng-26. 31p.

The effect of irradiation on the hydrolytic behavior of uranium monocarbide as related to the aqueous chemical processing of these reactor fuels is being investigated. The fabrication, evaluation, and encapsulation of the UC in niobium prior to irradiation is described. Uranium monocarbide buttons were prepared by arc-melting 1.51%-enriched uranium metal with the stoichiometric quantity of spectroscopic-grade carbon. The buttons were then remelted and drop-cast into graphite thimbles $\frac{3}{8}$ in. dia, and 3 in. long. The cylindrical castings were surface ground and cut into 0.17 in.-thick pellets, which were then polished. Preirradiation evaluation included metallography, chemical analysis, and hydrolysis studies. Microstructures of the final pellets indicated that the monocarbide was nearly stoichiometric; however, some α-uranium was present along with carbon contamination from the graphite thimbles. The use of tungsten-tipped electrodes in the arc-melting operation introduced about 0.3% of tungsten impurity. The composition of the pellets, as estimated from hydrolysis studies and chemical analyses was 92% UC, 3.5% $UC_2$, 4.0% uranium metal, and 0.3% WC. The UC pellets were encapsulated in niobium and subsequently shrunk-fit into a stainless steel cladding. The capsules were sealed by heliarc welding in a helium atmosphere chamber. (auth)

**18861** (REIC-Access-60(Rev.)&61(Pt.I)) MONTHLY ACCESSION LIST NO. 60 (REVISED) AND 61 [ON RADIATION EFFECTS DATA]. Abstracts, Part I. (Battelle Memorial Inst. Radiation Effects Information Center, Columbus, Ohio). Mar. 15, 1963. Contract AF33(657)-10085. 112p.

Abstracts of 734 articles concerning radiation effects which represent the monthly accession lists of material for the Radiation Effects Information Center, Battelle Memorial Institute, for the period of July 1, 1962 to Feb. 28, 1963, are presented. (H.G.G.)

**18862** (REIC-Access-60(Rev.)&61(Pt.II)) MONTHLY ACCESSION LIST NO. 60 (REVISED) AND 61 [ON RADIATION EFFECTS DATA]. Coordinate Index Part II. (Battelle Memorial Inst. Radiation Effects Information Center, Columbus, Ohio). Mar. 15, 1963. Contract AF33(657)-10085. 18p.

A coordinate index is provided for the 734 abstracts concerning radiation effects which were accessioned by Radiation Effects Information Center of Battelle Memorial Institute during the period July 1, 1962 to Feb. 28, 1963. The terms and concepts used to index these abstracts were selected on the basis of the REIC contract scope and 5-year operating experience. The personal author and corporate author indexes are included. (H.G.G.)

**18863** (TID-18438) RADIATION DAMAGE STUDIES IN SOLIDS USING THE TECHNIQUES OF ELECTRON-SPIN PARAMAGNETIC RESONANCE AND NUCLEAR MAGNETIC RESONANCE. Annual Progress Report, May 1, 1962–April 30, 1963. P. J. Bray and H. O. Hooper (Brown Univ., Providence). Mar. 1, 1963. Contract AT(30-1)-2024. 58p.

Nuclear magnetic resonance (NMR) techniques were used to examine the potassium halides. Attempts were made to obtain crystals with low dislocation contents in order to simplify the analysis of the NMR spectra before and after neutron irradiation. Data indicate that the F-center intensity measurements by electron spin resonance (ESR) show a close correspondence with the changes in NMR spectra for both KBr and KI irradiated with neutrons. Temperature

monitoring inside LiF crystals during neutron irradiation indicates temperature rises to at least 160°C when the samples are irradiated in an air-cooled facility. The temperature of some samples of LiF reached 300°C. The temperature is dependent upon the neutron flux, the cooling air of the facility, and the manner in which the samples are packaged and placed in the facility. The ESR studies of F-centers in neutron-irradiated crystals of LiF were conducted on crystals of 99.99 at.% Li and 95.6 at.% Li rather than the normal isotopic abundance of Li. Preliminary studies of radiation damage effects in LiBr and LiI by NMR techniques are discussed. ESR studies were conducted on irradiated alkali borate glasses with high oxide concentrations and glasses in the $CaO-B_2O_3-Al_2O_3$ system. The irradiated alkali borate glasses containing >30 mol % alkali oxide show a spectrum of four equally spaced lines which differs from the five-line spectrum found previously in irradiated alkali borate glasses containing < 25 mol % alkali oxide. This five-line spectrum was successfully analyzed in terms of the theoretical ESR line shape for the case of powder or glassy materials. An appropriate spin-Hamiltonian was found for the center responsible for the five-line structure. (auth)

**18864** (UNC-5046) SPONGE FUEL EVALUATION. Phase II Report, August 23, 1961 to January 31, 1963. J. M. McKee (United Nuclear Corp. Development Div., White Plains, N. Y.). Jan. 31, 1963. Contract AT(30-1)-2869. 74p.

A sponge fuel capsule irradiation started early in the current contract period had to be terminated prematurely because of unpredicted behavior. This capsule was then examined along with one from the previous contract period which had also failed prematurely. Examination showed that the cause of failure had been correctly interpreted from thermocouple data in both cases, but revealed some additional faults which needed to be corrected. In-pile sintering of sponge fuel appeared slight in 30 days at 1400°F, and moderate at 1600°F. Areas of dense U were formed in a second specimen by mechanisms which are not yet understood. Design work on two high-burnup capsules for use in further research on the sponge fuel concept is reported. (J.R.D.)

**18865** (VDIT-16(3.1)) RADIATION EFFECTS ON SOLID, URANIUM BASED NUCLEAR FUEL MATERIALS. Vol. 3, No. 1. A Bibliography. W. Uhlmann (Aktiebolaget Atomenergi, Stockholm). Mar. 1963. 33p.

A bibliography with abstracts concerning radiation effects on metallic U, alloys, ceramics, carbides and refractories, and dispersion fuels is presented. A total of 51 items are included. (J.R.D.)

**18866** (WAPD-TM-350) DIFFERENTIAL THERMAL ANALYSIS OF SOME IRRADIATED MATERIALS. R. M. Berman (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). Feb. 1963. Contract AT(11-1)-Gen-14. 18p.

Differential thermal analysis was successfully applied to highly radioactive irradiated materials through use of a disposable sample holder and appropriate remotely operated equipment. Measurement of the temperature at which radiation damage is annealed and the quantity of energy released was determined. The energy release of irradiated, amorphous $U_3O_8$ and $Al_2O_3$ associated with the return of crystallinity was measured. Results of these measurements indicate that these amorphous materials are supercooled liquids or true glosses. Negative results were obtained on differential thermal analysis runs on $UO_2$ and $ZrO_2-UO_2$. (H.G.G.)

**18867** (AEC-tr-5701) THE EFFECT OF COBALT-60 GAMMA RADIATION ON CdS. Tsunesaburo Asada, Masaharu Kawanishi, Hideo Ito, and Tadaoki Yamashita. Translated from Nippon Isotope Kaigi Hobunshu, No. 4, 611-14 (1962). 18p. (Includes original, 4p.).

Single crystals of CdS exhibit changes in electrical conductivity under irradiation with visible light and show a similar behavior with $\gamma$ radiation. With visible light only, the exposed surface layer shows this change in conductance; whereas gamma rays alter the conductance throughout the crystal because of their great penetrating power. The results of $\gamma$ irradiation, using cobalt-60 as $\gamma$ source, of CdS single crystals regarding sensitivity, temperature effects, time constants, and radiation damage are presented and show CdS to be a suitable material for use as a $\gamma$ ray detector. (H.G.G.)

**18868** IRRADIATION HARDENING IN COLUMBIUM. P. R. V. Evans (Armour Research Foundation, Chicago), A. F. Weinberg, and R. J. Van Thyne. Acta Met., 11: 143-50(Feb. 1963).

The influence of neutron irradiation on strength and ductility of columbium was studied as a function of grain size and irradiation temperature (77 to 330°C). Irradiation-induced hardening was analyzed in terms of $\sigma_i$, the frictional stress opposing the motion of dislocation, and the constant $k_y$ as determined from both a Petch-type equation ($\sigma_{LY} = \sigma_i + k_y d^{-\frac{1}{2}}$) and the extrapolation of stress-strain curves. The increase in lower yield strength on irradiation was found to be a function of irradiation dose and irradiation temperature, and was mainly due to an increase in $\sigma_i$. Both methods of analysis gave different and unexpected values for $k_y$. The irradiation hardening was accompanied by severe reductions in metal ductility and, in some cases, complete embrittlement. The loss of ductility at the relatively low total neutron doses examined ($7.5 \times 10^{19}$ nvt) was a function of irradiation dose, irradiation temperature, and grain size. Since the range of grain sizes studied included those levels characteristic of commercial wrought and recrystallized columbium, the severe effect of irradiation on ductility is of direct technological interest. The observed embrittlement of columbium after a relatively small amount of irradiation hardening is discussed. (auth)

**18869** CONTRIBUTION TO THE STUDY OF THE ELECTRICAL PROPERTIES OF IRRADIATED POLYETHYLENE. Edmond Fallah and Roland Coelho (Laboratoire Central des Industries Électriques, Paris). Compt. Rend., 256: 946-9(Jan. 21, 1963). (In French)

The current induced by x rays (low flux of 1.15 rad/sec maximum) was used to study the permanent modifications caused by preliminary irradiation in a reactor or by a cobalt source at absorbed doses between $8 \times 10^4$ to $2 \times 10^8$ rad. The conductivity increases with the dose up to several megarads. The results depend particularly on the irradiation flux. The dispersion of the results seems less great for the induced conductivity. It is shown that the natural conduction current decreases linearly with time after a short induction period. The slope varies with the dose absorbed. Between room temperature and 90°C, the natural conductivity of the irradiated polyethylene varies with the temperature following a law of the form $\sigma = \sigma_0 \exp(-W/kT)$, where the activation energy W depends on the absorbed dose. The results suggest that the induced inductivity has an electronic nature. (J.S.R.)

**18870** MEASUREMENT OF THE RECOMBINATION TIME OF MINORITY CARRIERS OF A SEMICONDUCTOR WITH RESPECT TO ITS APPLICATIONS TO NEUTRON MEASUREMENTS CONNECTED WITH THE WIGNER EF-

FECT. Jean-Claude Lanore and Roland Schuttler (Commissariat à l'Énergie Atomique, Paris). Compt. Rend., 256: 1264-6(Feb. 4, 1963). (In French)

If it is desired to predict the deterioration of solids by a reactor, it is important to measure the neutron flux with a detector whose response, as a function of energy, corresponds to the creation of faults in a solid. A method which permits measurement of the "recombination time" in silicon during irradiation is presented. (tr-auth)

**18871** RADIATION SOURCES OBTAINED BY IRRADIATION IN REACTORS. R. Henry, Y. Jolchine, Ph. Germond, E. Bouteiller, and A. Manin (Commissariat à l'Énergie Atomique, Paris). Energie Nucl., 4: 607-11(Dec. 1962). (In French)

The different radiation sources which can be fabricated from products irradiated in reactors are described. The sources considered are $\alpha$ sources ($Po^{210}$), $\beta$ and $\gamma$ sources which can be prepared from a hundred radioisotopes, but chiefly from $Co^{60}$ and $Ir^{192}$, neutron sources obtained by making Po $\alpha$ particles interact with Be, and tritium sources which can be used as neutron sources if they are bombarded with deuterons of sufficient energy. The fabrication and principal characteristics of these different sources are described, and examples of their utilization are indicated. (tr-auth)

**18872** SPIN RESONANCE IN NEUTRON-IRRADIATED SINGLE CRYSTALS OF GRAPHITE. K. A. Mueller (Battelle Memorial Inst., Geneva). Helv. Phys. Acta, 35: 617-51(1962). (In German)

An investigation of the conduction carrier spin resonance line of single crystals of graphite irradiated up to doses of $4.9 \times 10^{19}$ nvt thermal neutron flux at room temperature and to $3.9 \times 10^{20}$ nvt at 300°C is discussed in detail. The line shows the characteristic Dysonian shape. The resonance line in polycrystalline samples and single crystals have the same origin. The slight anisotropy of the asymmetry parameter A/B in unirradiated crystals decreases with radiation. The g-value for a magnetic field orientation parallel to the graphite c axis decreases monotonically as a function of the irradiation. The line width is also anisotropic. The intensity of the resonance as a function of room temperature irradiation shows a marked increase. The room temperature trap production was compared to the number of displaced atoms estimated from electron transmission microscopy. Trap annealing was studied with single crystals irradiated at room temperature. Radiation annealing was observed with single crystals irradiated at 300°C. The annealing of the spin resonance line of polycrystalline material irradiated with doses comparable to the critical one is discussed in terms of the present model. (J.S.R.)

**18873** FAULTS CREATED IN SOLIDS BY BOMBARDMENT WITH CHARGED PARTICLES. André Degeilh and René Simon (CNRS, Toulouse). Ind. At., 6: 57-62(1962). (In French)

The bombardment of a crystalline sample by charged particles causes permanent faults such as Frenkel pairs. The different theories relative to the interaction of incident particles with the target atoms are reviewed. Nuclear shocks, in opposition to electric shocks, can produce faults by displacing a certain number of atoms from the irradiated solid. It is shown that older theories do not agree with the experimental results. Recent theories that describe qualitatively the phenomenon of shock propagation in solids and lead to new quantitative results are reported. (tr-auth)

**18874** THE EFFECT OF IONIZING RADIATION ON ACRYLAMIDE-METHYLENEBISACRYLAMIDE GELS. Roy W. Roth and Robert F. Stamm (American Cyanamid Co., Stamford, Conn.). J. Appl. Polymer Sci., 7: 53-7 (Jan. 1963).

Acrylamide-methylenebisacrylamide gels (95/5 monomer ratio) of 10, 6, and 4% total monomer concentration were subjected to from 0 to 57.6 Mrad of ionizing radiation. With increasing radiation dosage, the gels first shrink because of further crosslinking, then rupture and break into gel particles. At a dose rate of 0.5 to 1 Mrad/sec, the gels absorb about 5 Mrad before degradation begins. Weaker gels (4%) absorb more irradiation before they degrade than will stronger gels (10%). (auth)

**18875** EFFECT OF RADIATION ON CREEP OF POLYETHYLENE. Joseph Marin and Paul B. Griesacker (Pennsylvania State Univ., University Park). J. Appl. Polymer Sci., 7: 133-41(Jan. 1963).

An investigation was conducted of the influence of radiation on the creep of polyethylene in tension and compression. The influence of five radiation doses and four stress levels were considered in this study. The tests were conducted for periods of 1000 hr. Even for small doses of radiation, it was found that the creep resistance of the material was increased. However, it should be noted that with decrease in creep deformations, the time to rupture for a given stress will very likely be decreased. In addition, the short-time properties may be adversely influenced by radiation. It is therefore necessary to select the optimum radiation dose based upon a consideration of all the properties. (auth)

**18876** EFFECT OF RADIATION ON TENSION, COMPRESSION, BENDING, AND SHEAR PROPERTIES OF POLYETHYLENE. Joseph Marin and Paul B. Griesacker (Pennsylvania State Univ., University Park). J. Appl. Polymer Sci., 7: 153-69(Jan. 1963).

The influence of various nuclear radiation doses on the short-time tension, compression, bending, and pure shear (torsion) stress-strain properties of polyethylene was investigated. In interpreting the test results, an attempt was made to determine the optimum radiation dose for each of the properties evaluated. In addition to the nominal tension and compression properties, the true stress-strain properties were determined. Nominal properties in bending and torsion were also found. For all four types of stress, the influence of radiation was found using four different doses of radiation. A second part of this study deals with the theoretical prediction of bending-curvature and torque-twist relations from the true stress-strain curves in tension and compression. A comparison of the predicted and actual relations for the various radiation doses considered shows good agreement between actual and predicted values. (auth)

**18877** MODIFICATION OF COTTON WITH ACRYLONITRILE BY RADIATION POLYMERIZATION. F. L. Saunders and R. C. Sovish (Dow Chemical Co., Midland, Mich.). J. Appl. Polymer Sci., 7: 357-74(Jan. 1963).

The modification of cellulose (cotton fabric or yarn) was carried out with acrylonitrile under ionizing radiation. Irradiation of the cotton in aqueous acrylonitrile solutions with gamma or electron radiation produces a modified cotton with improved rot and mildew resistance similar to that of cyanoethylated cotton. Strength properties are not significantly affected, provided the radiation dose is less than 5 Mrads. The pickup of acrylonitrile by cotton depends on monomer concentration, dose, and dose rate. It was also observed that water was necessary to give the desired uniform modification. Doses of 0.5 to 1.5

Mrads produced modifications in the range of 8 to 15%. Dose rate effects are present at low doses, where pickup decreases with increasing dose rate. Above 5 Mrads, dose rate effects are minimized. Although the data do not show whether actual grafting is occurring with the cellulose, either directly from radiation or through oxidative products formed in the water, or whether the cellulose is being swollen with the aqueous monomer solution which is then intimately polymerized by radiation fragments resulting from the radiation, it is apparent that polymer is formed uniformly upon or within the cellulose structure and that it cannot be removed by solvent extraction. As a result of the modification, the solubility of the cellulose in its usual solvents is decreased and other properties are modified, especially rot resistance, which is improved. Modification of cotton with monomers other than acrylonitrile was also considered. Pickups of styrene, acrylic acid, methyl isopropenyl ketone, ethyl acrylate, and methyl methacrylate were obtained from methanol-water solutions. (auth)

**18878** EFFECT OF GAMMA RADIATION ON THE CHARACTERISTICS OF LIQUID SCINTILLATORS. Gilbert Laustriat, Jean Klein, and André Coche (Centre de Recherches Nucleaires, Strasbourg). J. Chim. Phys., 59: 1182-8(Nov.-Dec. 1962). (In French)

It is shown that the irradiation of the solvent (toluene) by high doses of $\gamma$ radiation causes a decrease of the luminous yield of the liquid scintillators. This effect is due to the radiolysis products which act both by their inhibitory properties and by their spectral characteristics (absorption of the solute emission). The nature of these products depend on the irradiation conditions, principally the presence of air. (tr-auth)

**18879** STUDY OF AN OXIDE-CORED ELECTRON SOURCE HEATED BY HIGH-FREQUENCY INDUCTION. H. Bardeau and R. Picca (CNRS, Toulouse). J. Phys. Radium, 23: Suppl. No. 12, 137A-40A(Dec. 1962). (In French)

An oxide-cored cathode forming a plane electron source, geometrically well defined, with a high intensity at low temperature and giving a very fine electron beam is described. (auth)

**18880** EVIDENCE OF THE APPEARANCE AND DISAPPEARANCE OF THE LOOP STRUCTURES IN KCl CRYSTAL DUE TO ELECTRON IRRADIATION. Tadatosi Hibi and Keiji Yada (Tohoku Univ., Sandai). J. Phys. Soc. Japan, 18: 311(Feb. 1963).

The aperture lens of an electron microscope was covered with a thin carbon film (200-300Å) to remove the ion beam produced in the gun to confirm whether electron irradiation or ion bombardment is predominant in causing loop structures in KCl. In a single crystal of KCl a point defect was created only by electron irradiation without the function of ion bombardment. (C.E.S.)

**18881** GAS TRANSMISSION IN IRRADIATED POLYETHYLENE. Harris J. Bixler, Alan S. Michaels, and Morris Salame (Massachusetts Inst. of Tech., Cambridge). J. Polymer Sci., Pt. A, 1: 895-919(Mar. 1963). (In English)

The transmission of helium, nitrogen, methane, and propane was studied in samples of a high pressure, branched polyethylene (46% crystalline) irradiated to a dose in air of $10^8$ roentgens from a $Co^{60}$ source. By using a time-lag apparatus the permeability, diffusion, and solubility constants were measured in the temperature range 0 to 55°C. These data were compared with those obtained in samples of the above polymer before irradiation. Infrared analysis indicated that oxidation, unsaturation, and crosslinking had resulted from irradiation of the polymer. Because of a possible gradient in chemical composition through the irradiated films, the usual analysis of the time-lag data may not have been applicable to the present work. The apparent diffusion and solubility constants were, however, qualitatively consistent with the anticipated effects of the chemical and physical changes resulting from irradiation. The apparent solubility constants were uniformly higher by 40% in the irradiated film as compared to the values in the unirradiated films. No reduction in crystallinity was observed upon irradiation, so this increase was ascribed to the effect of chemical composition changes. A thermodynamically consistent increase in the apparent heats of solution was also observed. The apparent diffusion constants were lower in the irradiated samples with the fractional reduction increasing with gas molecular diameter. The reduction for helium was 30%, while that for propane was 54%. The apparent energies of activation for diffusion showed no significant change upon irradiation. Arguments are presented to indicate that the reduced apparent diffusion constants apparently arose from the mild crosslinking which had occurred in the amorphous phase. Comparisons are made between the gas transmission data obtained in the unirradiated samples with those for other high pressure, branched polyethylenes studied in light of a simple model for gas flow in the crystalline-amorphous matrix. (auth)

**18882** STUDY OF THE INFLUENCE OF TETRAHYDROFURANE ON THE RADIO CROSS LINKING OF POLYVINYL CHLORIDE. C. Wippler and R. Gautron (Centre de Recherches de la Cie. de St. Gobian, Antony, France). J. Polymer Sci., Pt. A, 1: 943-9(Mar. 1963). (In French)

An attempt was made to explain the crosslinking mechanism of PVC, when irradiated in the presence of tetrahydrofurane. Taking into account several experimental results, a very likely conclusion seems to be that a bridge between two PVC molecules consists in a THF molecule, of which the ring has been opened by the combined effects of the irradiation and of the chlorine or hydrochloric acid evolved from the PVC. (auth)

**18883** RADIATION-INDUCED CATIONIC POLYMERIZATION OF ETHYLENE. Yoneho Tabata, Hiroshi Shibano, Hiroshi Sobue, and Kiyoshi Hara (Takyo Univ.). J. Polymer Sci., Pt. A, 1: 1049-53(Mar. 1963). (In English)

Radiation-induced polymerization of liquid ethylene was investigated at −78°C. No induction period was observed. The rate of polymerization was proportional to the first power of the dose rate. Radical scavengers did not inhibit the polymerization. On the other hand, methylene chloride accelerated the polymerization appreciably. It was concluded that the polymerization of liquid ethylene at low temperature proceeds by a cationic mechanism. (auth)

**18884** ISOTHERMAL ANNEALING OF DEUTERON-IRRADIATED Al AND Au BELOW 60°K. K. Herschbach (Univ. of Illinois, Urbana). Phys. Rev., 130: 554-64 (Apr. 15, 1963). (TID-16343)

Foils, made out of 99.999% pure Al (4 mil) and 99.999% pure Au (2 mil), are bombarded with 21-Mev deuterons at a temperature not exceeding 8.5°K. With a total flux of $2.5 \times 10^{16}$ d/cm$^2$, the damage introduced is $0.33 \times 10^{-7}$ ohm-cm and $0.45 \times 10^{-7}$ ohm-cm, respectively, about five times smaller than the theoretical value. For Au the 1/E law for the damage production holds. No radiation annealing is observed for either metal. Isothermal annealing is performed in steps of 1°K for one hour at each temperature. Up to 50°K 65% of the damage anneals out in Al, 17% in Au. The isoch-

ronal plot of the resistance decrease for Al shows a small peak (5%) centered at 17°K, a large one at 34°K, and two at 39 and 46°K. The annealing in Au, appreciable already at the lowest annealing temperature, 9.7°K, is rather constant over the whole temperature range examined except for a large peak at 33°K and a smaller one at 45°K. Changes in the temperature-dependent part of the resistivity can for both metals be explained as a deviation from Mathiessen's rule, as resistance measurements at 6°K indicate. This result is in agreement with measurements on Al and Au alloys. The activation energy spectrum for Al, obtained with a frequency factor of lnB = 29, shows also 4 peaks, at 0.056, 0.110, 0.130, and 0.146 ev. The spectrum for Au is rather complex, because of the large range of the interaction of defects and the anisotropy of this metal. A recalculation of data for the annealing of deuteron-irradiated Cu and Ag shows a fine structure. A way to choose the proper temperature increase for isothermal annealing measurements is given. (auth)

**18885** THE EFFECT OF γ-RADIATION UPON THE PROPERTIES OF ELECTROLYTIC NICKEL. S. D. Gertsriken and N. P. Plotnikova. Sb. Nauchn. Rabot Inst. Metallofiz., Akad. Nauk Ukr. SSR, No. 12, 88-92(1961).

Electrolytic Ni specimens were irradiated with $Co^{60}$ in a $10^{14}$ to $10^{16}$ γ quanta/cm$^2$ dosage. X-ray inspections were performed with annealed specimens in large-size Debye and Sachs chambers in Cu irradiation. On the radiographs of irradiated specimens, broadening of the lines was observed, which is caused by dislocation-type failures. The average value of domain sizes for two irradiated specimens $(6.2 \pm 0.4) \times 10^{-6}$ cm does not depend on the irradiation dosage when it is changed by a factor of 3, namely from $2.3 \times 10^{16}$ to $6.8 \times 10^{16}$ γ quanta/cm$^2$. The average value of dislocation density is $N = (9.8 \pm 2.4) \times 10^{10}$ cm$^{-2}$. When the dosage of irradiating electrolytically remelted Ni (99.99%) varies by a factor of 30 ($7.2 \times 10^{14}$ to $2.2 \times 10^{16}$ γ quanta/cm$^2$), N increases from $4.10^9$ to $3.10^{10}$ cm$^{-2}$. The absence of a dependence of N in non-remelted Ni is explained by the fact that with a slight change in the irradiation dosage (by a factor of 3) N irradiation changes within a tolerance limit of determining the value. Measurements of microhardness showed that during irradiation it is raised by 1 to 2 units, which exceeds by about twice the mean square error in determining the hardness. (P.C.H.)

**18886** MEASUREMENT OF THE STORED ENERGY OF NaCl AFTER REACTOR IRRADIATION. Norbert Hennen (Technische Hochschule, Munich). Z. Angew. Phys., 15: 48-54(Jan. 1963). (In German)

The increase of the internal energy of NaCl was measured by the difference of the salt heat of solution before and after reactor irradiation at 70 to 90°C. The stored energy shows, as a function of the irradiation dose, divisible stages with a maximum of 1.1 cal/g NaCl. The possible mechanism was discussed and an estimation of the defect concentration was made. From the isothermal increase of the radiation damage, an activation energy of 1.18 ev and a reaction degree of the first order were determined for the temperature range 160 to 203°C and discussed. (tr-auth)

**18887** IRRADIATED FILLER-CONTAINING POLYETHYLENE. Alfred R. Gilbert and Frank M. Precopio (to General Electric Co.). U. S. Patent 3,084,114. Apr. 2, 1963. Filed Feb. 15, 1955.

It was found that irradiation of filled polyethylene resulted in improved mechanical properties. The various fillers which may be used are discussed. A high-voltage accelerating apparatus for producing electrons for irradiating polyethylene sheet is described. (D.L.C.)

# PHYSICS

## General and Miscellaneous

**18888** (AD-284411) HYPERFINE INTERACTIONS OF THE 2+ STATE IN $Dy^{160}$ SITUATED IN DYSPROSIUM IRON GARNET USING $\gamma$-$\gamma$ ANGULAR CORRELATION TECHNIQUE. Technical Note No. 7. S. G. Cohen and G. Gilat (Hebrew Univ., Jerusalem). June 1962. Contract AF61 (052)-347. 18p.

The hyperfine interaction of the 2+ state in $Dy^{160}$ situated in ferrimagnetic dysprosium iron garnet (DIG) was studied at room temperature by measuring the perturbation of the angular correlation of gamma-cascades passing through this state. A large rotation of the angular correlation pattern was observed when the domains were aligned in an external magnetic field perpendicular to the plane of the counters. A longitudinal external field was used to decouple the effectively static part of the hyperfine interaction and isolate the time-dependent interactions. The effective hyperfine interaction was found to be 160 ± 50 Ms/sec. Assuming $H_{eff}$ equals $6.0 \pm 10^5$ Oe, the g factor of the 2+ state has a calculated value of 0.32 ± 0.10. The relaxation times characterizing the time-dependent perturbations are estimated to be $(1.5 \pm 0.5) \times 10$ to the minus 12th power sec for DIG. (auth)

**18889** (AD-284457) THERMIONIC CONVERTER RESEARCH. Report No. 4. Final Report, July 1, 1961–June 30, 1962. Report No. 25057. R. Laubenstein, W. Beyermann, and B. Chang (Marquardt Corp., Van Nuys, Calif.). Contract DA36-039-sc-87217. 63p.

Two methods were investigated for production of positive ions for neutralizing the electron space charge in a thermionic converter which operates at relatively low temperatures. Low temperature converters with emitter temperatures of 1200°C or lower are potentially useful for operation with small heat sources which burn ordinary fossil fuels in air. Data were obtained on arc mode operation of Cs vapor diodes with Mo and with Philips B emitters at 1000 to 1300°C. Power densities of about 0.3 to 1.0 $w/cm^2$ were obtained depending on emitter temperature and material. The presence of an auxiliary electrode in the form of a radiation shield surrounding the emitter had a significant effect on diode performance with the Philips B emitter. The effects of the auxiliary electrode include an increased power output and an increased voltage at maximum power. With the Philips B emitter the maximum power output occurred at a lower Cs pressure than with the Mo emitter. Materials which emit positive ions at 1000 to 1200°C were also studied. (auth)

**18890** (AD-284753) LONG LIFE CLOSED LOOP MHD RESEARCH AND DEVELOPMENT UNIT. Interim Scientific Report No. 2, June 15, 1962–September 15, 1962. (Westinghouse Electric Corp. Research Labs., Pittsburgh). Contract AF33(657)-8311. 94p.

The design parameters for a long-life closed-loop magnetohydrodynamic (MHD) generator and pump in which a seeded gas is pumped around the loop under thermodynamic conditions approaching those expected in large-scale MHD generators suitable for extraterrestrial applications are discussed. The status of the closed loop duct and its auxiliary components is reported. Experimental results from tests on a small straight-through MHD generator are presented. These tests on the straight-through generator were run to obtain information on the closed loop project. (H.G.G.)

**18891** (AFCRL-62-766) THE MAGNETO-IONIC THEORY FOR BOUND ELECTRONS. Report 1116-25. H. Unz (Ohio State Univ. Research Foundation. Antenna Lab., Columbus). Oct. 1, 1962. Contract AF19(604)-7270. 16p. (AD-286858)

The magneto-ionic theory for bound electrons is developed. The result includes the Appleton-Hartree equation as a particular case. The case when the Lorentz term is included in the theory is discussed. (auth)

**18892** (ASD-TDR-62-1111) SUPERCONDUCTIVITY IN METALS AND ALLOYS. W. H. Cherry, G. D. Cody, J. L. Cooper, G. Cullen, J. I. Gittleman, J. J. Hanak, M. Rayl, and F. D. Rosi (Radio Corp. of America. RCA Labs., Princeton, N. J.). Jan. 2, 1963. Contract AF33 (657)-7733. 70p. (AD-299983)

Measurements were made of the Kapitza resistance in tin, indium, and sapphire and its change at the superconducting transition. An attempt to detect an electric field dependence of the Kapitza resistance in platinum had negative results. A method for the preparation of $\beta$-tungsten compound superconductors, such as $Nb_3Sn$, was developed. Properties of the deposited material and the extension of this method to such possible $\beta$-tungsten compounds as niobium germanide, niobium silicide, vanadium-gallium, vanadium silicide and niobium-gallium are described. The transition temperature of niobium stannide is shown to depend not only on the stoichiometry, but also on the state of order of the lattice. Resistivity of $Nb_3Sn$ is given as a function of temperature from 4.2 to 370°K. Tunneling measurements on deposited $Nb_3Sn$ indicate the existence of a bandgap ($2\epsilon_0$). Preliminary results are compatible with the relation: $2\epsilon_0 \approx 1.8\ T_c$. Thermal conductivity measurements were made on $Nb_3Sn$ from 4.2 to 25°K. Penetration depth measurements were made on deposited $Nb_3Sn$. The temperature dependence is similar to that obtained for other superconductors, but the value of the penetration depth at T = 0°K (2880 Å) is almost an order of magnitude greater than that observed for soft superconductors. Quenching currents were measured on deposited $Nb_3Sn$. For transverse fields the quenching current drops rapidly, whereas for longitudinal fields the quenching current rises. (auth)

**18893** (BNL-6277) OPTIMUM DESIGN OF AN ATOMIC BEAM MAGNETIC RESONANCE APPARATUS. Edgar Lipworth and Gerald Minerbo (Brookhaven National Lab., Upton, N. Y.). [nd]. Contract AT(30-2)-Gen-16. 31p.

The design of an atomic beam magnetic resonance apparatus adjusted to observe "flop-in" signals and employing Robi type deflecting magnets is discussed. The number of atoms reaching the detector per second depends on such parameters as the length of the inhomogeneous magnets, the width of the various slits, and the oven temperature. Efforts to calculate exactly the signal strength in a symmetrical apparatus and the use of a digital computer to investigate the dependence of the signal on apparatus parameters are discussed. (H.G.G.)

**18894** (EDR-2978) INVESTIGATION OF THE MONO-CAPILLARY THERMIONIC EMITTER AS A DUAL SOURCE OF IONS AND ELECTRONS. Quarterly Technical Prog-

ress Report No. 3, May 15–August 15, 1962. D. L. Dresser and W. Laurita (General Motors Corp. Allison Div., Indianapolis). Aug. 15, 1962. Contract AF33(616)-8299. 32p. (AD-283262)

Theoretical work on a capillary thermionic emitter model in which the neutral Cs density varies from a high entrance value to a low exit value is reported. The plasma density, the sheath potential, and the sheath thickness vary along the capillary in the model. Electron emission predicted by the model is compared with experimental results obtained on a monocapillary structure. Results obtained in 43-hr experimental runs by multicapillary converters show that the power densities in these converters may be 10 to 50 times as great as those in conventional Ta systems. The capillary converter data demonstrate an insensitivity to electrode spacing over the range from 0.5 to 1.0 mm. The preparation procedure is given for operating the converters, and factors related to failure are reviewed. (J.R.D.)

**18895** (ISS-62/16) SEMICONDUTTORI ORGANICI (RASSEGNA). (Organic Semiconductors. A Survey). A. Sargentini (Italy. Instituto Superiore di Sanità, Rome). Apr. 26, 1962. 20p.

Results of a survey on recent experiments concerning the conductivity of organic semiconductors are presented. Information is included on molecular crystals of aromatic compounds and change-transfer complexes. Particular attention is paid to experiments with anthracene and with carrier mobility measurements. (J.R.D.)

**18896** (LADC-5318) TURBULENT VISCOSITY IN ROTATING He II. Paul P. Craig (Los Alamos Scientific Lab., N. Mex.). [1961]. Contract [W-7405-eng-36]. 8p.

The decay of the rotating velocity field on cessation of the rotation of He(II) is discussed. The decay is found to be describable in terms of solutions to the classical Stokes-Navier equations of fluid flow, but the kinematic viscosity varies with the square root of the steady-state rotational velocity and with temperature. The behavior may be quantitatively understood on the basis of a simple model involving vortex line turbulence. Solutions to the Stokes-Navier equation were obtained for cylindrical flow in two dimensions in a vessel of radius R on instantaneous cessation of rotation. The experimental results are discussed in conjunction with a model consistent with them. (M.C.G.)

**18897** (LADC-5443) CONCERNING THE SECOND ORDER ELECTRIC FIELD DUE TO A CONDUCTION CURRENT. Don A. Baker (Los Alamos Scientific Lab., N. Mex.). [1962]. Contract W-7405-Eng-36. 13p.

Assuming that the fields of a moving point charge as computed from the retarded Liénard-Wiechert potentials give valid descriptions for moving electrons, it is shown that no net second order static electric field of the type discussed by Rosser appears on the axis of a charge neutral circular loop carrying a steady current. An argument is given for the nonexistence of such "residual" electric fields around any closed, charge-neutral region in which the current flow is time independent. (auth)

**18898** (MND-SR-2428) DATA TELEMETRY PACKAGE POWERED BY A STRONTIUM-90 GENERATOR. (Martin Co. Nuclear Div., Baltimore). Sept. 30, 1960. Contract AT(30-1)-2519. 142p.

Work accomplished on design and fabrication of an automatic, nuclear-powered, remote meteorological data transmitting radio station and equipment for a manned receiving station is reported. Two years of continuous unattended operation is the primary aim of the design Work on the $Sr^{90}$ thermoelectric generator includes design, fabrication, and electrical test of a 5-W system and coordination of the $Sr^{90}$ loading with ORNL. (J.R.D.)

**18899** (NP-12343) CORRELATION SPLITTING IN THE HYDROGEN MOLECULE. Ernest R. Davidson and Leon L. Jones (Wisconsin. Univ., Madison. Theoretical Chemistry Lab.). Mar. 14, 1962. Contract NOrd-15884. 17p. (CF-2977; AD-274631)

The difference between the energy of the best open shell and best closed shell wave functions for the H molecule were calculated for various values of the internuclear distance. Both left-right and in-out correlated functions were considered. The relative importance of the type of correlation reverses at an internuclear distance of 0.8 Bohrs. (auth)

**18900** (NP-12667) VAPOR-FILLED THERMIONIC CONVERTERS. First Quarterly Report, October 1, 1962 to December 31, 1962. K. G. Hernqvist and J. R. Fendley (David Sarnoff Research Center, Princeton, N. J.). Jan. 20, 1963. Contract NAS 3-2531. 19p.

An analysis of the Cs vapor arc discharge is described. It is assumed that the discharge operates in the ball-of-fire mode, that cumulative ionization via the two resonance-excited states is the predominant ionization mechanism, and that trapping in the plasma of the resonance radiation results in a long effective lifetime of the states. A volt-ampere characteristic is derived for the Cs arc, and the results are applied to the thermionic energy converter. Good qualitative agreement is obtained between theory and experiment. A duo-emitter diode for microwave studies of a Cs plasma and its application in a circuit are described. The ion emitter and electron emitter face each other. A test station for the monitoring and control of the gas environment in an operating Cs diode is described. It is a metal-ceramic system to which a mass spectrometer is attached for analysis of gases in the converter. Provisions are made for introducing different gases in addition to Cs. (auth)

**18901** (NYO-9783) POWER FLATTENING STUDIES FOR RADIOISOTOPE-THERMOELECTRIC GENERATORS. Final Report. R. E. Rush and H. Belofsky (General Instrument Corp. Thermoelectric Div., Newark, N. J.). Feb. 18, 1963. Contract AT(30-1)-2783. 132p.

The natural exponential decay of a radioisotope used as a heat source for a thermoelectric generator makes the use of a "power flattening" device highly desirable, especially when the duration of the mission is large compared to the half life of the radioisotope. Power-flattening devices are considered which either dump excess heat outside the thermoelectric generator or use the characteristics of the generator to absorb the excess heat and thereby regulate the hot junction temperature. A number of power-flattening devices were studied both analytically and experimentally with a view toward operability in space. The most promising concepts are (a) to utilize a secondary radiator of variable area; (b) to provide thermal shunts that are sequentially removed during the mission; (c) to use a secondary radiator coupled to the heat source through a slowly evaporating thermal connection. (auth)

**18902** (R-410-PR) THE QUANTUM ELECTRODYNAMICS OF A MEDIUM. H. T. Yura (RAND Corp., Santa Monica, Calif.). Mar. 1963. 86p.

By using the Feynman diagram technique, a unified analysis is made of the quantum electrodynamics of a medium. Both an atomic medium and an electron gas are considered.

The photon propagator in a medium is calculated by summing the most highly divergent diagram in each term of the perturbation series expansion of the photon propagator. An explicit form for the interaction amplitude of two arbitrary currents in a medium is provided, from which a complete complex dielectric function is defined (at the pole of the photon propagator). Furthermore, the photon propagator is examined for its poles to obtain dispersion relations which yield the energy-momentum relation for free motion of the system. Explicit dispersion relations are found for both an atomic system and an electron gas over a wide range of energy and momentum variables. Damping (i.e., conductivity) and finite temperature effects are also discussed. The energy loss of fast incident charged particles passing through an atomic medium is obtained from the self-energy of the incident particle in the medium. The energy loss consists of three parts: loss due to excitation of atoms, loss due to ionization of atoms, and a Cherenkov loss. General features of the energy loss are discussed, and a number of expressions are given for the loss of various incident particles. 22 references. (auth)

**18903** (RADC-TDR-62-264) INTERACTION OF MICROWAVE RADIATION WITH A WEAKLY IONIZED GAS. A. Peskoff (General Electric Co. Missile and Space Div., Valley Forge Space Technology Center, King of Prussia, Penna.). Aug. 1962. Contract AF 30(602)-1968. 31p. (AD-284180)

Propagation of intense microwaves in a plasma is studied. Simplified considerations are used to study the energy gain of an electron acted on by an alternating electric field, collisions with heavy particles, and collisions with other electrons. The conditions under which each of these instances is important are illustrated. The Boltzmann equation is applied to a plasma in which conditions vary slowly compared to the time-variation of the applied microwave field. Elastic, excitation, and ionization collisions are included in the analysis. The current vs voltage relation is studied for several idealized collision cross sections under steady state conditions. The dispersion relation (dependence of the wave number on the microwave frequency) is derived and is found to depend on the electric field intensity. A variational principle that may prove useful in finding the ionization rate using a trial function for the electron velocity distribution function is given. (auth)

**18904** (TID-14713) TREATMENT OF ZEEMAN AND HYPERFINE ANISOTROPY IN ELECTRON PARAMAGNETIC RESONANCE. J. A. McMillan (Argonne National Lab., Ill.). Nov. 1961. Contract [W-31-109-eng-38]. 26p. (UAC-5812)

The different cases of anisotropy of the Zeeman and hyperfine interaction tensors as applied to molecules and ions that have one unpaired electron were studied. Typical experimental results are discussed. (auth)

**18905** (TID-16660) REDISTRIBUTION OF THE CONDUCTION ELECTRONS DUE TO POINT DEFECT COMPLEXES IN METALS. Technical Report No. 33. K. H. Bennemann (Illinois. Univ., Urbana). July 1962. Contract AT(11-1)-182. 41p.

The wave functions of the conduction electrons in metals containing interstitials, vacancies, and impurities were determined by an integral equation derived from the Hartree-Fock equation. These wave functions take into account the effect of miltiple scattering arising from an ensemble of point defects and are used to determine the redistribution of the conduction electrons and the electronic contribution to the interaction energy of point defects. (auth)

**18906** (TID-16739) CRATERING EXPERIMENTS WITH LARGE HIGH EXPLOSIVE CHARGES. L. J. Vortman (Sandia Corp., Albuquerque, N. Mex.). [Sept. 1962]. Contract [AT(29-1)-789]. 34p. (SCDC-2846)

Activities in a program to investigate parameters affecting craters from high-explosive charges are described. Factors investigated include charge burial depth, media, and charge shape. The investigation was conducted to determine whether the data can be extrapolated to very large explosions. It was found that overburden scaling has a slight advantage over a method which shows that crator volumes are proportional to the charge weight and linear dimensions are proportional to the cube-root of the charge weight. (J.R.D.)

**18907** (TID-17310) PULSED-MAGNETIC-FIELD STUDIES OF SUPERCONDUCTING TRANSITION METAL ALLOYS AT HIGH AND LOW CURRENT DENSITIES. T. G. Berlincourt (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). [1962]. Contract [AT(11-1)-Gen-8]. 15p.

Data are presented that show that in concentrated alloys $H_r(J \rightarrow 0)$ (the magnetic field which first restores detectable resistance for vanishing measuring-current density) is nearly independent of defect concentration and relative orientations of field, current, and defect structure. Values of $H_r$ (J = 10, T = 1.2°K) approaching 150 kgauss were observed for certain ductile transition metal alloys. In addition, high-current-density data are presented that suggest that Ti–Nb and Ti–Ta alloys are suitable for 100 to 120 kgauss superconducting magnets. $H_r$ (J = 10, T = 1.2°K) was plotted against average number of valence electrons per atom for Ti–V, Ti–Nb, Ti–Ta, and Zr–Nb. Results seemed to establish $H_r(J \rightarrow 0)$ as a fundamental parameter approximately equivalent to $H_{C2}$ of Abrikosov's theory. (M.C.G.)

**18908** (TID-18303) LOW TEMPERATURE EFFECTS ON HIGH VOLTAGE BREAKDOWN AT SMALL GAPS. [PART] I. D. J. DeGeeter (Argonne National Lab., Ill.). May 16, 1962. Contract W-31-109-eng-38. 18p.

Experiments were performed that examined the effect of electrode cooling on breakdown. Cooling the cathode to liquid $N_2$ temperature reduced the d-c electron current, thereby increasing the voltage breakdown value. Tests involving cooling of only one electrode indicated that only the cathode was affected. Cooling was found to be of probable value if the flaking problem were removed when the cathode has a high field region. The data indicated that breakdown would not necessarily be improved for all electrode geometries, especially when the data do not approach the Trump-Van de Graaff curve against which the data were plotted. Effects of electrode polishing and outgassing were also studied. (D.C.W.)

**18909** (TID-18436) PASSAGE OF CHARGED PARTICLES THROUGH MATTER. Technical Report No. 2. Hans Bichsel (University of Southern California, Los Angeles). Jan. 6, 1961. Contract AT(04-3)-136. 48p.

Areas examined are the stopping power and range energy relation for heavy charged particles with attendant shell corrections, straggling of heavy particles, coulomb and multiple scattering, average energy loss per ion pair, and passage of electrons through matter. Tables display values of parameters used in calculating stopping powers for various proton energies (0.1 to 700 Mev), calculated values of proton stopping powers for several substances and elements (2 to 600 Mev), proton stopping powers for several substances (0.05 to 6 Mev), various shell corrections, pathlengths for 2.5 to 1000 Mev protons in several substances, experimental maximum ranges and theoretical pathlengths

of 100 kev electrons and positrons in several substances, an average energy for ion pair formation for various particles, and some multiple scattering and proton straggling relations. Other relations are plotted, and a bibliography of 88 references to fairly recent literature on passage of charged particles through matter is included. (D.C.W.)

**18910** (UCRL-7221) HYDRODYNAMIC PRESSURE MEASUREMENT IN GRANITE NEAR AN UNDERGROUND NUCLEAR EXPLOSION. D. B. Lombard and D. V. Power (California. Univ., Livermore. Lawrence Radiation Lab.) Mar. 14, 1963. Contract W-7405-eng-48. 12p.

A peak shock pressure of 664 ± 40 kbar was measured in granite near the underground nuclear explosion "Hardhat" at the Nevada Test Site in February 1962. Two Al plates fitted with pin contactors were grouted into drill holes at ranges of 15.0 and 15.9 ft from the center of detonation; the closer instrument was ruined by moisture prior to the explosion. Pulses generated by the shock front hitting pins in the instrument at 15.9 ft were recorded on an accurate time base. The shock speed in Al was computed from the recorded data. This speed, together with the known Hugoniot equations of state of Al and granite, was used to calculate the peak shock pressure in granite. The result is in good agreement with calculations based on hydrodynamic theory and with independent measurements. A second set of pins, intended to measure the free-surface velocity of the Al plate (and hence the mass velocity behind the shock front), did not function properly. (auth)

**18911** (UCRL-7271) THE CALCULATION OF STRESS WAVES IN SOLIDS. Mark L. Wilkins and Richard Giroux (California. Univ., Livermore. Lawrence Radiation Lab.). Mar. 11, 1963. Contract W-7405-eng-48. 15p.

Finite difference techniques are used to solve the continuum equations in two dimensions with axial symmetry. The Tresca yield assumption is used in an equation of state that describes elastic, elastic-plastic, and hydrodynamic flow. Problems are presented where stress waves are induced in solids from the detonation of high explosives, and from the impact of two materials. The effect of strength of materials on wave shapes and on exterior boundaries is shown as a function of time. (auth)

**18912** (FTD-TT-62-1719) ON ANGULAR DISTRIBUTION OF IONS OF ALKALI ELEMENTS, DIFFUSED BY THE SURFACE OF METAL. U. A. Arifov, A. Kh. Ayukhanov, and A. A. Aliyev. Translated from Izv. Akad. Nauk Uz. SSR, Ser. Fiz.-Mat. Nauk, No. 6, 5764(1961).

Experiments conducted in a glass vacuum instrument to obtain data on angular distribution of metal ions resulting from the bombardment of metal surfaces by positive ions are described. It was found that when the mass of the bombarding ions ($m_2$) is lower than the mass of target atoms ($m_1$), the angular distribution of scattered ions coincides closely with the cosine graph. The angular intensity distribution of scattered ions in the range investigated under conditions of $m_2 < m_1$ does not depend on the bombarding ion energy and target temperature. With increase of incidence angle of primary ions, the coefficient of secondary scattered ions increases. (J.R.D.)

**18913** (FTD-TT-62-1797) ON THE THEORY OF AN ASYNCHRONOUS MAGNETOHYDRODYNAMIC GENERATOR WITH A ROTATING FIELD. E. (Ye.) I. Yantovskii (Yantovskiy) and I. M. Tolmach. Translated from Izv. Akad. Nauk SSSR, Otd. Tekhn. Nauk, Energ. i Avtom., No. 3, 32-41(1962). 18p.

Previously presented equations describing the flow of a conducting gas in a magnetohydrodynamic generator (MHDG) with a rotating field are generalized by taking into account the dependence of the gas conductivity on density and temperature, by not averaging with respect to the transverse coordinate and time, and by taking into account the voltage drop across the stator winding and the characteristics of the winding. A system of equations for an actual scheme of an asynchronous MHDG is obtained, and the concept of vector diagrams of an a-c MHDG is introduced. The process of direct conversion of a part of the kinetic energy of the gas to electrical energy and its entry into the network is illustrated with local and over-all vector diagrams. (auth)

**18914** (FTD-TT-62-1810) INVARIANT GROUP SOLUTIONS OF THE EQUATIONS OF A PLANAR STATIONARY BEAM OF CHARGED PARTICLES. V. A. Syrovoy. Translated from Zh. Prikl. Mekhan. i Tekhn. Fiz., No. 4, 10-20(1962). 23p.

The equation representing a laminar normal nonrelativistic beam in the absence of an external magnetic field is presented, and the invariant group solutions of the equation in cartesian coordinates are examined. Similarly, the invariant group solutions of the equations for monoenergetic beams in a magnetic field perpendicular to the plane of flow are analyzed. Focusing electrodes necessary to achieve flows described by the latter solutions are also discussed. (D.C.W.)

**18915** (FTD-TT-62-1893) DETERMINATION OF THE OPTIMUM COMPOSITION OF GASEOUS MIXTURES CONTAINING AN EASILY IONIZABLE ADDITIVE. E. P. Zimin and V. A. Popov. Translated from Zh. Prikl. Mekhan. i Tekhn. Fiz., No. 3, 10-14(1962). 12p.

The conductivity of a gas can be increased, within the framework of the thermal ionization mechanism, only by increasing the electron concentration. An effective method for increasing the electron concentration without raising the temperature is to replace some of the atoms of the basic gas with atoms of a gas having a low ionization potential. The conductivity of such a mixture was determined not only by the electron concentration and the effective cross section of collisions between electrons and atoms of the basic gas, but also by the effective cross section of collisions between electrons and atoms of the additive. Calculations of the optimum compositions of a mixture is reasonably simple for weakly ionized mixtures, but is quite complex for relatively high degrees of ionization and ions with effective cross sections that depend on the electron concentration. Methods for diluting the vapor of easily ionizable metals with practically non-ionizable gases to create mixtures that have conductivities at a given temperature and pressure that are higher than that of the vapor of the pure metal are described. The use of such a dilution is limited by temperature and pressure. (H.G.G.)

**18916** (UCRL-Trans-928(L)) DERIVATION BY STATISTICAL MECHANICS OF THE LAW OF DEPENDENCE OF THE COMPRESSIBILITY OF SOLIDS ON TEMPERATURE. Piero Giorgio Bordoni. Translated for Univ. of California Lawrence Radiation Lab., Livermore from Atti Accad. Naz. Lincei, Rend., Classe Sci. Fis., Mat. Nat., 6: 597-602(1949). 13p.

The dependency of elastic constants of solids on temperature was considered previously from a predominantly empirical angle, and attempts to infer a dependency law theoretically did not lead to concrete results. The use of statistical methods and selection of a suitable form of the state equation which make it possible to overcome pre-

viously encountered difficulties and to determine a relationship between isothermal compressibility and absolute temperature that agrees satisfactorily with experimental data, are described. The relationship was obtained by means of procedures of a substantially mechanical character in which a solid, constituted by n atoms, is an aggregate of 3n quantized oscillators, and selecting as Lograngian coordinates the amplitudes of the vibration modes. The dependency law which was inferred has a universal character in that its expression is identical for all solids that fall within the mechanical pattern considered. The physical properties of the various substances are found to be synthesized in a single multiplicative coefficient. (H.G.G.)

**18917** REMARKS ON THE EVALUATION OF SOME INTEGRALS IN THE RELATIVISTIC CORRECTIONS TO THE BINDING ENERGY OF THE $H_2$ MOLECULE. L. Wolniewicz (Nicholas Copernicus Univ., Toruń, Poland). Acta Phys. Polon, 22: Suppl., 3-11(1962). (In English)

An expansion in the elliptic coordinates of the inverse powers of the interelectronic distance $r_{12}$ in terms of the Geganbauer polynomials is given. It is shown, that this expansion allows — by means of standard numerical methods — the evaluation of integrals containing in the integrand any inverse power of $r_{12}$, and a formula convenient for the numerical calculations is presented. (auth)

**18918** ATOMIC POLARIZABILITIES AND SHIELDING FACTORS. A. Dalgarno (Geophysics Corp. of America, Bedford, Mass.). Advan. Phys., 11: 281-315(Oct. 1962). (In English)

A discussion is given of the methods of calculating atomic polarizabilities and shielding factors, and the relationships between them are demonstrated. The formulation of the uncoupled Hartree-Fock approximation is presented, and it is shown that the methods are all approximate versions of it. A more accurate procedure, the coupled Hartree-Fock approximation, is described. Comprehensive tables of dipole and quadrupole polarizabilities and of quadrupole shielding factors are included together with an assessment of the probable accuracy. (auth)

**18919** PERTURBATION THEORY FOR DOUBLE-TIME TEMPERATURE-DEPENDENT GREEN FUNCTIONS. S. V. Tyablikov (Steklov Mathematical Inst., Moscow) and V. L. Bonch-Bruevich. Advan. Phys., 11: 317-48(Oct. 1962). (In English)

A perturbation theory is developed for normal many-particle systems by expanding the inverse of the advanced and retarded Green functions. Both systems with direct interactions and systems with interactions through a quantum field are considered. For the former, the infinite set of coupled equations is written down and the various methods of decoupling discussed. Systems with weak, hard-sphere type, or coulomb interactions are considered and the connections with other methods discussed. For systems with quantum field interactions, the chain of equations involves both fermion and boson Green functions and the first approximation can be very accurate. This latter approach seems to be more convenient when collective oscillations are important. (auth)

**18920** ON TRANSIENT MAGNETOHYDRODYNAMIC FLOW IN CHANNELS. L. N. Tao (Illinois Inst. of Tech., Chicago). AIAA (Am. Inst. Aeron. Astronaut.) J., 1: 461-2(Feb. 1963).

Magnetohydrodynamic flow in a channel of insulating walls is investigated for any change in the time-dependent axial pressure gradient. The velocity field and induced electric and magnetic fields are of the oscillatory type with decaying amplitudes. Special cases such as a sudden start and a sudden removal of the pressure gradient are considered. (C.E.S.)

**18921** ON THE COMBINATION OF PROBABILITY AND RELATIVITY. Y. Ahmavaara. Ann. Acad. Sci. Fennicae, Ser. A, VI, No. 116, 9p.(1962). (In English)

Classes of mathematic models in which both probability and relativity can be said to be involved are discussed in probabilistic terminology. Mathematically, this implies combination of a group notation with probabilistic structure in a way that may be useful in applied mathematics. The best known example of a model, where both relativity and probability are involved, is the formalism of quantum theory. (C.E.S.)

**18922** ANOMALOUS TRANSMISSION OF X RAYS IN COPPER CRYSTALS. M. C. Wittels, F. A. Sherrill, and F. W. Young, Jr. (Oak Ridge National Lab., Tenn.). Appl. Phys. Letters, 2: 127-9(Apr. 1, 1963).

The anomalous transmission of x rays in nearly perfect copper crystals is reported. The apparent absorption coefficient of x rays becomes abnormally small when an incident beam undergoes a Bragg reflection during passage through the crystal. The incident radiation was Cu $K\alpha_1$ monochromated by (111) reflection from a perfect silicon crystal on to the 1 $cm^2$ face (110) of thickness 0.05 to 1.3 mm. Apparent individual imperfections are revealed as light images in the transmitted beam image. (C.E.S.)

**18923** LASER-INDUCED EMISSION OF ELECTRONS, IONS, AND NEUTRAL ATOMS FROM SOLID SURFACES. R. E. Honig and J. R. Woolstron (Radio Corp. of America Labs., Princeton, N. J.). Appl. Phys. Letters, 2: 138-9 (Apr. 1, 1963).

Studies of various solids — conductors, semiconductors, and insulators — irradiated in a vacuum with a focused beam from a pulsed ruby laser are described. Work was undertaken to detect and identify the ions, electrons, and neutral atoms emitted. The targets studied include Cu, Mo, Ta, W, stainless steel, and graphite, semiconductors of Ge and SiC, and one insulator $Al_2O_3$. The ion spectra obtained include considerable concentrations of singly and multiply charged species typical of the target and also species representing background gases. (C.E.S.)

**18924** PHOTO ELECTRON MEASUREMENTS OF L LEVELS IN THE ELEMENTS STRONTIUM (Z = 38) TO PALLADIUM (Z = 46). Anders Fahlman, Olle Hoernfeldt, and Carl Nordling (Uppsala Univ.). Arkiv Fysik, 23: 75-80(1963). (In English)

The photoelectron method was applied for precision measurements of the $L_I$, $L_{II}$, and $L_{III}$ binding energies in the elements strontium (Z = 38) to palladium (Z = 46). For technetium (Z = 43) no experimental determinations of the electron binding energies were previously reported. Good agreement is found with theoretical predictions for spin and screening doublet splittings, whereas a comparison with x-ray data shows discrepancies that are significant. (auth)

**18925** INVESTIGATIONS INTO THE WIDTHS OF SOME X-RAY EMISSION LINES. Goesta Brogren (Chalmers Univ. of Tech., Göteborg). Arkiv Fysik, 23: 219-28 (1963). (In English)

The true width of an x-ray emission line can be obtained as the difference between the observed width of the line in the (1 + 1) position and the width of the rocking curve in the (1 – 1) position, provided that the crystal gratings used are perfect, that the line is symmetric, or nearly symmetric, and that the absorption coefficient of

the crystal is negligible. If the line is slightly asymmetric and/or the absorption is slight, this correction procedure gives values of the line widths, which must be very near the true widths. The relation is verified experimentally by registering some K emission lines and the $L\alpha_1$-line of tungsten. The correction leads to new values on the widths of x-ray emission lines, which are considerably smaller than the present accepted values. The broadening due to imperfect crystal gratings cannot be calculated and no correction can be applied. A corresponding investigation of the connection between line widths and crystal broadening in absorption spectra would be both very interesting and useful. (auth)

**18926** THE Z-DEPENDENCE OF ENERGIES AND RELATIVE INTENSITIES IN THE K-LL AUGER SPECTRUM. Olle Hoernfeldt (Uppsala Univ.). Arkiv Fysik, 23: 235-45(1963). (In English)

The formulas deduced by Asaad and Burhop for calculating K-LL Auger energies were adjusted to experimental data by introducing a new expression to approximate the electrostatic interaction energy between the two vacancies in the final state of the atom. Using the modified formulas, the K-LL Auger energies were calculated for eighty-one elements, the Z-values ranging from 20 to 100. In most cases the agreement with observed energies is better than 0.05% or within the errors of the measurements. Using published experimental data, the intensities of the lines in the K-LL spectrum relative to that of the $K\text{-}L_1L_1$ ($^1S_0$) transition were with one exception (the $K\text{-}L_1L_2$ transitions) demonstrated to be linearly dependent on Z or $Z^{-2}$. This empirically obtained Z-dependence is different from the theoretical predictions by Asaad and Burhop, and by Callan. (auth)

**18927** THE X-RAY L-ABSORPTION SPECTRUM OF 46 Pd. Erik Noreland (Uppsala Univ.). Arkiv Fysik, 23: 273-81(1963). (In English)

The three L-absorption edges of Pd were recorded, using a bent crystal vacuum spectrometer and a proportional counter. The results are published in the form of curves that show the absolute value of the mass absorption coefficient as a function of wavelength. The wavelengths and energies of the absorption limits were measured, with the following results: $L_{III}$: $\lambda$ = 3899.3 XU, E = 3173.0 ev; $L_{II}$: 3715.0 XU, E = 3330.3 ev; $L_I$: $\lambda$ = 3429.9 XU, E = 3607.2 ev. (auth)

**18928** THE EFFECT OF A VERTICAL MAGNETIC FIELD ON RAYLEIGH-TAYLOR INSTABILITY. P. H. Roberts (Yerkes Observatory, Williams Bay, Wis.). Astrophys. J., 137: 679-89(Feb. 15, 1963).

Two semi-infinite incompressible fluids of equal kinematic and magnetic viscosities, $\nu$, but differing density, $\rho_1$, $\rho_2$, lie at rest in a uniform gravitational field perpendicular to the plane interface between them. A uniform vertical magnetic field pervades the system. The growth rate, n, of the instabilities which develop when the denser fluid ($\rho_2$) overlies the lighter fluid ($\rho_1$) is deduced as a function of k, the horizontal wave number. It is shown that, if the magnetic field is sufficiently strong (more precisely, if the Alfvén velocities, $V_1$, $V_2$, are large compared with $[\nu g]^{\frac{1}{2}}$, where g is the acceleration of gravity) n is almost constant for a large range of k; namely, for $g/V^2 \ll k \ll V/\nu$. In this range, $n \cong g/V_2 - g/V_1$. The magnetic field does not significantly affect the growth rate for either small or large wavelengths. (auth)

**18929** THE THEORY OF ROTATION SPECTRA. O. Bor and B. Mottelson (Inst. of Theoretical Physics and Northern Inst. of Theoretical Atomic Physics, (NORDITA), Copenhagen). At. Energ. (USSR), 14: 41-4(Jan. 1963). (In Russian)

The theory of rotation spectra indicates a simple correlation between the characteristics of a given rotation band; the parameters which depend on the rotating system, may be estimated on the basis of simple models. The rotation energy is considered as the function of the components of the angular momentum within the coordinate system of the nucleus. Many systematic studies were carried out on E2 transitions. The intensity of these transitions may be especially sensitive toward higher-order members. Conditions leading to forbidden transitions were reviewed. The appearance of members dependent on components of the angular momentum in the transition probability expressions may be attributed to action of forces on internal motion. The values of the coefficients of the members may be calculated from the internal structure of the nucleus, deriving members independent from the component directly from the internal state of the static field of the nucleus. Higher order effects arise as the result of the rotation of the field and may be estimated in the same manner as moments of inertia from the coercive rotation model. (TTT)

**18930** SOME EXPERIMENTAL RESULTS CONCERNING THE POSSIBILITY OF DIRECT CONVERSION OF THERMAL ENERGY INTO ELECTRICITY WITH M-G-D METHODS. J. Milewski and J. Śmigielski. Bull. Acad. Polon. Sci., Ser. Sci., Tech., 10: 429-34(1962). (In English)

A brief review is given of results obtained in the direct conversion of thermal energy into electricity with magneto-gas-dynamic methods. Many difficulties connected with combustion at temperatures of the order of 3000°K were avoided by application of the arc plasmatron. The output power obtained ranged from a fraction of a watt to 200 k watts depending on the size of the apparatus. The working life was, depending on the durability of the materials used, from a few seconds to 30 minutes. (C.E.S.)

**18931** AN IMPROVED BRIDGMAN APPARATUS FOR PREPARATION OF ORGANIC MIXED CRYSTAL SCINTILLATORS. Sohachiro Hayakawa, Tokihisa Nakamura, and Shigeo Kobayashi. Bull. Tokyo Inst. Technol., Spec. No. 49, 91-6(1962). (In English)

An improved apparatus is designed to prepare large organic mixed crystals by the Bridgman method. An attached program controller makes the temperature of the furnace decrease very slowly. A sample tube is orientated to obtain crystal slices with uniform concentrations. Details of the apparatus and the procedure are shown and factors exerting influences on the preparations are discussed. (auth)

**18932** NEUTRON SPECTRUM OF A Pu–Be SOURCE. P. Huber, Z. Lewandowski, R. Plattner, C. Poppelbaum, and R. Wagner (Universität, Basel). Helv. Phys. Acta, 35: 557-8(1962). (In German)

The spectrum of a Pu–Be source with 80 g Pu was determined using the time-of-flight method. The spectrum obtained is shown and is in good agreement with the Broek-Anderson measurement in the range 2 to 9 Mev. Two maxima at 3 and 5 Mev were resolved. Pu fission and inelastic scattering of neutrons on the source material produce a significant low-energy contribution to the neutron spectrum. (J.S.R.)

**18933** PULSED THERMAL DESORPTION OF STAINLESS STEEL NS-22S IN ULTRAVACUUM. L. A. Petermann (Battelle Memorial Inst., Geneva), B. Lux, D. A. Degras,

and A. Schram. Helv. Phys. Acta, 35: 696-714(1962). (In French)

The general aim of studies, of which a part is described, is the detailed knowledge of the mechanisms for interaction between gases and solids usable in ultravacuum technology. In particular, the relative importance of phenomena of adsorption, desorption, and diffusion of gas in the vicinity of a stainless steel surface (walls of an ultravacuum installation) was investigated. The method discussed is that of pulsed thermal desorption (flash filament). The results obtained with stainless steel samples (NS-22 S, Ugine) can be explained using two simple physical models; the first leads to the determination of gas-solid surface bonding energies, the second gives the distribution function of the gas absorbed by the solid in the vicinity of the surface. (tr-auth)

**18934** RELATIVE SIGNS OF NUCLEAR SPIN COUPLING CONSTANTS: A REFINEMENT OF THE DOUBLE-IRRADIATION EXPERIMENT. R. Freeman and N. S. Bhacca (Varian Associates, Palo Alto, Calif.). J. Chem. Phys., 38: 1088-93(Mar. 1, 1963).

The application of a very weak perturbing radio-frequency field in nuclear magnetic double-resonance experiments in such a way as to irradiate just a single resonance transition is shown to give information about the relative signs of the spin coupling constants in systems of three or more spins. The method is not restricted to near first-order spectra and may be used even when several multiplets overlap. It was applied to the determination of the relative signs of the couplings in 1,2-dibromopropane, and the results agree with those of Finegold, who used conventional analysis methods. The sign of a long-range coupling is reported. (auth)

**18935** THERMOLUMINESCENCE IN QUARTZ. W. L. Medlin (Socony Mobil Oil Co., Inc., Dallas). J. Chem. Phys., 38: 1132-43(Mar. 1, 1963).

X-ray- and uv-excited thermoluminescence in natural quartz was investigated by studying the properties of synthetic samples. The results for a large number of natural samples, including single crystals, outcrop specimens, and core-hole samples showed that most of them had four prominent glow peaks in common. One of these is due to the presence of Ti and the others are apparently associated with a defect center. The effects of annealing at temperatures up to 900°C were found to be important in well-crystallized samples but unimportant in others. The emission spectrum of the Ti glow peak shows that a number of levels are involved in the luminescent transitions. All of the defect-center glow peaks have the same emission spectrum which consists of a single maximum with a long wavelength tail. Direct-current electrical measurements on single crystals showed that the trap-emptying processes for the defect center were nonlocalized. Optical absorption measurements at room temperature indicated that none of the common absorption bands are associated with peaks in the glow curve. From phosphorescent-decay measurements it was determined that the trapping levels associated with the defect center have very narrow energy distributions whereas the trapping level due to Ti is discrete. The glow peaks for ordinary quartz are not excitable by uv irradiation, but in samples annealed at 900°C all of the glow peaks due to the defect center are excited by uv. The annealed samples show absorption in the uv region which is not present in unannealed specimens. The results suggest changes in the trap-filling mechanism, but the effects can also be explained by alterations in the luminescent levels. Luminescence can be excited in all the samples at fixed temperatures by x rays but not by uv. At low temperatures the effects of transitions through trapping levels are unimportant, and the emission is due only to x-ray excitation of the luminescent centers. The spectral response of the emission is the same as that for the Ti glow peak. The intensity is about the same in all samples and is not affected by impurity content. This indicates that the luminescent levels involved are due to a crystal defect center and that the same center is involved in the thermoluminescence due to Ti. (auth)

**18936** UNITED-ATOM CONFIGURATION-INTERACTION TREATMENT OF THE He–He REPULSION. R. V. Miller and R. D. Present (Univ. of Tennessee, Knoxville). J. Chem. Phys., 38: 1179-82(Mar. 1, 1963).

The repulsive interaction between two normal He atoms is treated by the one-center method, using Slater-type orbitals, for the united-atom configurations $1s^2 2s^2$ and $1s^2 p\sigma^2$ which are appropriate at smaller and larger internuclear distances, R, respectively. A previous calculation by Huzinaga treated the $1s^2 2\sigma^2$ but not the $1s^2 2s^2$ configuration. The $1s^2 2s^2$ energy is found to be below the $1s^2 2p\sigma^2$ energy when $R < 0.56$ a.u. Mixing these two configurations leads to little improvement in the energy; the further admixture of $1s^2 3d\sigma^2$ gave a negligible improvement. However, when the basic configuration at small R, $1s^2 2s^2$, was mixed with the singly excited configuration $1s3d\sigma 2s^2$, a significant improvement was found (6.2 ev at $R = 0.5$ a.u.). When the singly excited configuration is admixed, the one-electron interaction with the two nuclei contributes to the nondiagonal matrix element and this leads to a greater configuration interaction than for the doubly excited configurations. Although the two-center method gives better results at $R = 1$ a.u., the one-center method with only two configurations appears to be definitely superior for $R \geq 0.6$ a.u. when compared with extrapolated energies obtained from the best two-center calculations. With other configurations included, the one-center method should compete with two-center calculations at $R = 0.75$ a.u. The results tend to confirm the disagreement found between the latest scattering experiments and the most accurate two-center calculations. (auth)

**18937** MICROWAVE SPECTRUM, SPECTROSCOPIC CONSTANTS, AND ELECTRIC DIPOLE MOMENT OF $Li^6F^{19}$. L. Wharton (Harvard Univ., Cambridge, Mass.), W. Klemperer, L. P. Gold, R. Strauch, J. J. Gallagher, and V. E. Derr. J. Chem. Phys., 38: 1203-10(Mar. 1, 1963).

Transitions between the $J = 1$ and $J = 0$ rotational states of $Li^6F^{19}$ were measured by means of the molecular-beam electric resonance method in the four lowest vibrational states. By this means the rotational constants of $Li^6F^{19}$ were determined. These enabled one to properly assign the rotationally resolved infrared vibration-rotation spectrum of $Li^7F^{19}$ observed by Vidale and to determine the correct vibrational constants. Transitions between the $M = 0$ and $|M| = 1$ orientations of the $J = 1$ rotational state of $Li^6F^{19}$ in the four lowest vibrational states in a strong electric field were measured to high precision, which enabled one to determine the dipole moments accurately and to observe a nonlinear variation of dipole moment with vibrational state. The molecular constants obtained for $Li^6F^{19}$ were: $B_v = 45.2308111 - 0.7223089(v + \frac{1}{2}) + 0.0058270(v + \frac{1}{2})^2 \pm 0.0000050$ Gc, $\omega_v = 964.07 - 8.895(v + \frac{1}{2})$ cm$^{-1}$, $r_e = 1.563892 \pm 0.000050$ Å, $\mu_v = \{6.28446 + 0.08612(v + \frac{1}{2}) + 0.00060(v + \frac{1}{2})^2\} \pm 0.00100$ D. (auth)

**18938** THEORETICAL INTERPRETATION OF FORCE CONSTANTS. Lionel Salem (Harvard Univ., Cambridge, Mass.). J. Chem. Phys., 38: 1227-36(Mar. 1, 1963).

The quantum-mechanical definition of the force constant k of a diatomic molecule is given. The three main approaches to the calculation of force constants — the perturbation approach, the virial theorem approach, and the strict Hellmann-Feynman approach — are discussed. Several new expressions for k are derived. In particular the Hellmann-Feynmann theorem leads to a general expression for k in terms of the charge density $\rho$ and of the change $\partial\rho/\partial R$ with internuclear distance R. It is also possible to relate the force constant to the quadrupole coupling (eqQ) of either nucleus by the formula $k = Z_A[q_A + \frac{4}{3}\pi\rho(A) - \int (\partial\rho/\partial X_A)\,(\cos\theta_A/r_A^2)\,d\tau]$. The experimentally observed relation $k \cong q_H$ for diatomic hydrides is then interpreted in terms of the properties of the charge density of these molecules. (auth)

**18939** RARE-EARTH PHOSPHORS. Hans J. Borchardt (E. I. du Pont de Nemours and Co., Wilmington, Del.). J. Chem. Phys., 38: 1251(Mar. 1, 1963).

A new class of efficient luminescent materials is reported which consists of rare earths incorporated into certain oxygen-dominated host lattices. Typical compositions are $(Y_{0.9}Eu_{0.1})_2O_3 \cdot WO_3$, $(Gd_{0.8}Eu_{0.2})_2O_3 \cdot MoO_3$, $(La_{0.6}Eu_{0.4})_2O_3 \cdot 3WO_3$, and $(Gd_{0.7}Eu_{0.3})_2O_3 \cdot 3MoO_3$. They emit red light when excited in the ultraviolet. (D.L.C.)

**18940** SUM RULES RELATING COHERENT X-RAY SCATTERING DATA TO THE DIAMAGNETIC NUCLEAR SHIELDING CONSTANT AND TO THE SELF-ENERGY OF THE CHARGE DISTRIBUTION OF THE SCATTERER. Jeremiah N. Silverman (National Bureau of Standards, Washington, D. C.) and Yukio Obata. J. Chem. Phys., 38: 1254-5(Mar. 1, 1963).

Two sum rules are derived for relating coherent x-ray scattering data to the expectation values of certain quantities. By means of the sum rules, the absolute value of the diamagnetic nuclear magnetic coupling constant $\sigma_d$ can be determined experimentally from x-ray scattering. The $\sigma_d$ for Br was computed to be $305 \times 10^{-5}$, as compared with $308 \times 10^{-5}$ derived from Hartree functions. (D.L.C.)

**18941** POSITIVE ION BEAMS. M. R. Gavin, K. Chandra, and L. J. Lloyd (University Coll. of North Wales, Bangor). J. Electron. Control (1), 14: 121-8(Feb. 1963).

A simple ion source is described for producing a parallel beam of monoenergetic argon ions. A h-f discharge produces the ions and the beam is extracted through a lens system consisting of two apertures, with a grid in the aperture of the accelerating electrode. Beams can be produced up to 5 mA with diameter 2.5 cm and length 10 cm. (auth)

**18942** PSEUDO-HIGH-ENERGY POSITIVE IONS IN PLASMA JETS. H. H. Teh (Univ. of Malaya, Kuala Lumpur). J. Nucl. Energy, Pt. C, 4: 415-16(Dec. 1962).

When an arc discharge is maintained in argon between an emitting tungsten cathode and a cold anode with a small orifice separating it from a low-pressure chamber, an intense flow of gas emerges through the hole carrying with it small droplets or fragments of tungsten. It is shown that the beam in the low-pressure chamber is a plasma jet and that deflexion experiments have led to the erroneous conclusion that 1000 ev positive ions emerge from an arc with 60 v potential drop. (auth)

**18943** EMISSION OF HIGH-ENERGY IONS FROM LOW-VOLTAGE ARCS. COMMENTS ON H. H. Teh's PAPER. E. R. Harrison (Rutherford High Energy Lab., Harwell, Berks, Eng.). J. Nucl. Energy, Pt. C, 4: 417(Dec. 1962).

Experimental agreements and disagreements are pointed out concerning the paper "Pseudo-High-Energy Positive Ions in Plasma Jets," H. H. Teh, J. Nucl. Energy, Part C, 4: 415-416, Dec. 1962. (C.E.S.)

**18944** A GEOMETRICAL METHOD OF INVESTIGATING DISPERSION RELATIONS. Ryogo Hirota and Soitiro Tosima (Labs. RCA, Inc., Tokyo). J. Phys. Soc. Japan, 18: 304(Feb. 1963).

An analog between complex potentials in electrostatic theory or hydrodynamics and dispersion relations was established. (C.E.S.)

**18945** THE FUNDAMENTAL THEOREM OF CONTINUOUS TRANSFORMATIONS IN QUANTUM THEORY. Gyoergy Marx. Magy. Tud. Akad. Kozp. Fiz. Kut. Int. Kozlemen., 6: 397-407(Sept.-Oct. 1958). (In Hungarian)

The unitary operator that is the generator of symmetry transformations in the Hilbert space is constructed, starting from the field equations and the commutation law. The train of thought is the reverse of that followed by Schwinger in the covariant formulation of the quantum theory and eliminates some inadequacies of previous treatments. (auth)

**18946** A VARIATION PRINCIPLE FOR ARBITRARY OPERATORS. L. M. Delves (Univ. of New South Wales, Kensington, Australia). Nucl. Phys., 41: 497-503(Mar. 1963). (In English)

A variation principle, linear in the hamiltonian, is given for the expectation value of an arbitrary operator W over bound states. A particular case of the results is a variation principle for the wave function itself. In general, the principle does not give a bound. An example is given to illustrate the method. (auth)

**18947** MOTION OF ELECTRONS IN THE IONOSPHERE IN THE PRESENCE OF AN ALTERNATING MODULATED ELECTRIC FIELD. A. Pozzi (Centro di Fisica dello Spazio, Naples). Nuovo Cimento (10), 26: 1309-14(Dec. 16, 1962). (In Italian)

After a brief analysis of the methods by which the motion of electrons in the ionosphere can be studied, Bailey's equations are discussed. The energy equation used to determine the collision frequency of electrons was deduced using a macroscopic approach. The number of parameters on which the solution depends was studied by a dimensional analysis, and a method of solving the equation was presented. The accuracy of the method was checked when the ratio $W_0/GT$ is of the order of magnitude of one. (auth)

**18948** ON THE BORCHERS CLASS OF A FREE FIELD. H. Epstein (CERN, Geneva). Nuovo Cimento (10), 27: 886-93(Feb. 16, 1963). (In English)

It is shown that the Borchers class of a free field A is formed by finite linear combinations of normal products of derivatives of A. (auth)

**18949** ON THE POSSIBILITY OF A MACROSCOPICALLY CAUSAL QUANTUM-RELATIVISTIC THEORY. B. Ferretti (Università, Bologna). Nuovo Cimento (10), 27: 1503-5(Mar. 16, 1963). (In English)

On the basis of the idea that the generation and detection of signals cannot be thought of as being associated with space-time points, but must be associated with finite regions in space-time, it is shown to be possible to construct a macroscopically causal free-field theory. The application of these results to the case of two interacting scalar fields is also discussed. (T.F.H.)

**18950** GENERAL DESCRIPTION OF ACCOMPLISHED EXPERIMENTS. G. R. Bishop (Ecole Normale Supérieure, Orsay, France). Onde Elec., 42: 289-309(Apr. 1962). (In French)

General descriptions, methods and results obtained for a series of typical experiments performed with the Orsay linear accelerator at 1.3 Bev are presented. Most of the

experiments made use of complete gamma apparatus. Studies were made on: the electro- and photodisintegration of $O^{16}$; energy loss by ionization and the Landau curve; charge distributions of $O^{16}$ and $O^{18}$ nuclei; elastic and inelastic interactions of electrons on the nuclei, $Al^{27}$ nuclei, levels collected from the nuclei of $Fe^{54}$, $Fe^{56}$, and $S^{32}$, and excitation of the giant resonance and the end radiation. (P.C.H.)

**18951** QUALITATIVE MECHANISM FOR SUPERCURRENT DESTRUCTION BY α-PARTICLES. N. Cabibbo (CERN, Geneva) and S. Doniach. Phys. Letters, 4: 29-30(Mar. 1, 1963). (In English)

Supercurrent destruction in a thin Pb ring by α particles was observed in a previous experiment, and a mechanism is proposed that could provide an explanation of this decay. This mechanism requires the possibility of the stable confinement of magnetic flux in the body of the superconductor. This takes the form of a tube in the normal conducting state that is surrounded by a sheath of supercurrent. The energy loss of the α particle provides sufficient energy to cause a transition to the normal state over a definite area. The magnetic field that enters this hole is proportional to the field inside the ring. The regrowth of the superconducting state occurs across the hole in such a way that the minimum flux remains trapped. (C.E.S.)

**18952** POSSIBLE NEW ATOMIC RESONANCES. W. Brandt (New York Univ., New York) and S. Lundqvist. Phys. Letters, 4: 47-8(Mar. 1, 1963). (In English)

In the course of a study of the response of atoms to external fields, theoretical evidence was found for the possibility of new resonances in atoms that are different from single-particle type excitations. They mark the coherent response of an atom as a whole. To the extent that preliminary calculations for a simple statistical model applies to real atoms, it is concluded that the new atomic resonances may appear over a more or less extended intermediate range of atomic frequencies. (C.E.S.)

**18953** COULOMB AND LORENTZ GAUGES IN GRAVITODYNAMICS. A. Peres (Israel Inst. of Tech., Haifa). Phys. Letters, 4: 58(Mar. 1, 1963). (In English)

Spinor formalism is used to define the energy and momentum of a gravitational field, quantization being the ultimate goal. Two simple sets of supplementary conditions, which are the natural generalizations of the familiar Coulomb and Lorentz gauges in electrodynamics, are shown to exist. (C.E.S.)

**18954** SPECIFIC HEAT, ENTROPY, AND EXPANSION COEFFICIENT OF LIQUID HELIUM-THREE. A. C. Anderson, W. Reese, and J. C. Wheatley (Univ. of Illinois, Urbana). Phys. Rev., 130: 495-501(Apr. 15, 1963). (TID-17389)

The specific heat of liquid $He^3$ is measured over the temperature range 0.015 to 0.3°K at pressures of 0.12, 6.45, 14.6, 21.4, and 28.8 atm. The specific-heat curves are fitted to polynomials suitable for the calculation of absolute entropies. The isobaric thermal expansion coefficient is measured over the same temperature interval at pressures of 14.4, 21.1, and 28.5 atm, and is found to be negative over the entire region investigated. The thermodynamic consistency of these two sets of measurements is discussed. (auth)

**18955** WEAK-COUPLING RATE EQUATIONS AND INITIAL CONDITIONS. Robert L. Peterson (Case Inst. of Tech., Cleveland). Phys. Rev., 130: 612-17(Apr. 15, 1963).

Irreversible rate equations for the diagonal and off-diagonal elements of the density matrix are derived in the weak-coupling, long-time approximation for two types of crystal perturbations — electron scattering from random impurities, and spin-spin interactions. No initial random phase assumption on the density matrix is necessary in the derivation using the random perturbation. For the spin-spin interactions, a "partial" initial random phase assumption is introduced and used in a natural way. It is shown, alternatively, that if one takes into account the very extensive cancellation of terms for the vast majority of unperturbed energy states, no initial restrictions need be placed on the majority of the density matrix elements. In all three cases the equations obtained are the same, being Pauli equations for the diagonal density matrix elements, but simpler relaxation-oscillation equations for the off-diagonal elements. (auth)

**18956** REPULSIVE INTERACTION POTENTIALS BETWEEN RARE-GAS ATOMS. HOMONUCLEAR TWO-CENTER SYSTEMS. Adolf A. Abrahamson (City Coll., New York and Brookhaven National Lab., Upton, N. Y.). Phys. Rev., 130: 693-707(Apr. 15, 1963). (BNL-6395)

Using a theoretical expression based on the Thomas-Fermi-Dirac statistical model of the atom, the repulsive interaction energies U(R) between a homonuclear pair of neutral rare-gas atoms are calculated at internuclear distances R ranging from $0.01a_0$ to $8.0a_0$. ($a_0 = 0.529$ Å.) The calculations agree with experiment. Specifically, for the He-He interaction, the calculated U(R) nearly coincides with theoretical and experimental results up to $R \sim 5a_0$, excepting some measurements at $R \lesssim 2a_0$. Similar and progressively closer accord with experiment is obtained for the Ne-Ne and Ar-Ar interactions. For Kr-Kr and Xe-Xe, agreement is reasonable up to separations of $\sim 6a_0$ and $\sim 7a_0$, respectively. Curves for the Rn-Rn interaction are also obtained. Comparison of the experimental data with Bohr's screened Coulomb potential, and with a proposed potential, shows that for $R \lesssim 1a_0$, the former decreases far too rapidly with increasing R, while for $R \lesssim 3a_0$, the latter falls off much too slowly. For extrapolations towards small R, the (12−6) potential is found to rise rapidly to values exceeding the experimental ones by several times 100%, whereas the (exp−6) potential or its repulsive part consistently remains within an order of magnitude of the empirical values and often considerably closer. Whether this latter behavior is fortuitous or not is not determined. (auth)

**18957** ENERGY AND MOMENTUM DENSITY IN FIELD THEORY. Julian Schwinger (Harvard Univ., Cambridge, Mass.). Phys. Rev., 130: 800-5(Apr. 15, 1963).

It is shown that the energy density commutator condition in its simplest form is valid for interacting spin 0, ½, 1 field systems, but not for higher spin fields. The action principle is extended, for this purpose, to arbitrary coordinate frames. There is a discussion of four categories of fields and some explicit consideration of spin ³/₂ as the simplest example that gives additional terms in the energy density commutator. As the fundamental equation of relativistic quantum field theory, the commutator condition makes explicit the greater physical complexity of higher spin fields. (auth)

**18958** RADIATION GAUGE ELECTRODYNAMICS. I. THE TWO-POINT FUNCTION. C. R. Hagen (Massachusetts Inst. of Tech., Cambridge). Phys. Rev., 130: 813-20 (Apr. 15, 1963). (TID-17326)

The Lehmann representations of the spin zero and spin one-half Green's functions are studied with particular emphasis upon infrared effects. By means of a Bloch-Nordsieck type model the infrared parts of these functions

are calculated and the analytic properties of the solution examined. A double integral representation of the two-point function is proposed and a possible application suggested. (auth)

**18959** PRESSURE COEFFICIENT AND COMPRESSIBILITY OF LIQUID $He^4$ VERY CLOSE TO THE λ CURVE. O. V. Lounasmaa (Argonne National Lab., Ill., and Univ. of Turku, Finland). Phys. Rev., 130: 847-51(May 1, 1963). (TID-18179)

Measurements of the pressure coefficient $\beta_v = (\partial p/\partial T)_v$ and the compressibility $\kappa_T = -(1/V)(\partial V/\partial p)_T$ in the immediate vicinity of the point $p_\lambda = 13.04$ atm, $V_\lambda = 24.20$ cm$^3$/mole, $T_\lambda = 2.023$°K are described. For $\beta_v$ the smallest increments were $\Delta T \simeq 2 \times 10^{-5}$°K and for $\kappa_T$ they were $\Delta p \simeq 1 \times 10^{-3}$ atm corresponding to $\Delta V/V \simeq 8 \times 10^{-6}$. Close to the λ curve $\beta_v$ is a linear function of $\log|T - T_\lambda|$ and $\kappa_T$ has a discontinuity at the transition point amounting to about 10% of its value. The results are discussed on the basis of thermodynamic equations derived recently by Buckingham and Fairbank. (auth)

**18960** ELECTRON VELOCITY DISTRIBUTION IN A SLIGHTLY IONIZED GAS WITH CROSSED ELECTRIC AND STRONG MAGNETIC FIELDS. Gary A. Pearson and Wulf B. Kunkel (Univ. of California, Berkeley). Phys. Rev., 130: 864-8(May 1, 1963). (UCRL-10536)

Assuming $(\omega_b \tau)^2 \gg 1$, equations that determine the electron energy distribution and drift velocity in the E × B drift frame of reference are derived, including a detailed treatment of inelastic collisions. These equations are valid when E, B, and the distribution function of the gas molecules are spacially uniform and constant in time, the component of E along B is negligible, and $E \ll B$ (in Gaussian units). The equations are suitable for numerical computations if the electron velocity distribution is assumed to be isotropic in the E × B drift frame. When the rms molecular speed in this frame is much smaller than the rms electron speed, the equations can be greatly simplified. Although the resulting equations are not new, this derivation clarifies their physical interpretation and limitations. The treatment is, of course, also applicable to cases where slightly ionized gas is moving across a magnetic field. (auth)

**18961** ELECTRON IONIZATION FREQUENCY IN HYDROGEN. William B. Cottingham (Bell Telephone Labs., Whippany, N. J.) and S. J. Buchsbaum. Phys. Rev., 130: 1002-6(May 1, 1963).

The frequency of ionization by electrons in hydrogen was measured during pulsed microwave breakdown in a waveguide. Optical radiation emanating from the plasma was used to determine the temporal rate of growth of electron density. Values of the ionization frequency are presented as a function of $E_e/p_0$ for $36 < E_e/p_0 < 200$ v/cm-mm Hg. The measurements constitute an extension of the work of Madan, Gordon, Buchsbaum, and Brown who measured this coefficient up to an $E_e/p_0$ of 40 v/cm-mm Hg by microwave cavity techniques. Comparison is made with previous d-c measurements of Rose and with the theory of Allis and Brown. Good agreement is obtained with the measurements of Rose but not with the theory of Allis and Brown extended to high $E_e/p_0$, nor with the previous microwave measurements of Madan et al. (auth)

**18962** ANISOTROPIC ELECTRON DISTRIBUTION AND THE DC AND MICROWAVE AVALANCHE BREAKDOWN IN HYDROGEN. G. A. Baraff and S. J. Buchsbaum (Bell Telephone Labs., Murray Hill, N. J.). Phys. Rev., 130: 1007-19(May 1, 1963).

The Boltzmann transport equation is solved taking into account vibrational, dissociation, excitation, and ionization losses in hydrogen at $E/p_0$ between 40 and 450 v/cm-mm Hg. No approximations are made regarding the angular dependence of the electron distribution function. At the high $E/p_0$ the distribution function is sufficiently anisotropic that it cannot be represented by a two-term expansion in spherical harmonics. It is shown that the concept of effective field in microwave breakdown remains valid in the presence of anisotropies provided the circular frequency is much larger than the electron growth rate. The temporal growth rate of the electron density is calculated and compared with the experiments of Rose and of Cottingham and Buchsbaum. The effects of anisotropy on the diffusion coefficient and on the microwave breakdown equation are discussed. (auth)

**18963** EXTRAPOLATION OF ELECTRON-RARE GAS ATOM CROSS SECTIONS TO ZERO ENERGY. Thomas F. O'Malley (New York Univ., New York). Phys. Rev., 130: 1020-9(May 1, 1963).

Modified effective-range formulas recently developed for electron-atom scattering are employed first to analyze the Ramsauer–Kollath (RK) electron-rare gas atom cross sections, and then to compare them with determinations of the same quantities made by different and newer methods. It is found that these cross sections can be extrapolated unambiguously down to zero energy. The extrapolated RK scattering lengths are found to be approximately 1.19, 0.24, −1.70, −3.7, and $-6.5a_0$ for He, Ne, Ar, Kr, and Xe, respectively. Good agreement is found, in general, both in sign and magnitude with the pressure shift estimates of the scattering lengths. Momentum transfer cross sections are also extended down to zero energy and are compared with some drift velocity and microwave results. The best agreement is found with the Gilardini and Brown curve for Ne, and with those of Pack, Phelps, Frost, and Voshall for the other rare gases, although there are some differences with the latter. In particular, a "pressure effect" is discussed in connection with these results. (auth)

**18964** FURTHER RESULTS CONCERNING HALF-INTEGRAL HYLLERAAS EXPANSIONS. H. M. Schwartz (Univ. of Arkansas, Fayetteville). Phys. Rev., 130: 1029-32(May 1, 1963).

Previous calculations concerning the ground state of two-electron atoms, involving Ritz-Hylleraas expansions with half-integral powers, are continued through expansions involving 31 parameters. As far as can be judged from a comparison of the energies with those obtained with other expansions, the results continue to be favorable. Thus, already with 18 parameters, the computed energies for He and O VII differ from the best published values by 2 and 0.3 parts per million, respectively. Even better results are obtained for He with expansions involving both half-integral and negative powers. A few initial results of calculations for the excited state $2\ ^1S$ are also presented. (auth)

**18965** QUANTIZED GRAVITATIONAL FIELD. Julian Schwinger (Harvard Univ., Cambridge, Mass.). Phys. Rev., 130: 1253-8(May 1, 1963).

A gravitational action operator is constructed that is invariant under general coordinate transformations and local Lorentz (gauge) transformations. To interpret the formalism, the arbitrariness in description must be restricted by introducing gauge conditions and coordinate conditions. The time gauge is defined by locking the time axes of the local coordinate systems to the general coordinate time axis. The resulting form of the action operator, including the contribution of a spinless matter field, enables canonical pairs of variables to be identified. There are four field variables that lack canonical partners, in virtue of differ-

ential constraint equations, that can be interpreted as space-time coordinate displacements. In a physically distinguished class of coordinate system the gravitational field variables are not explicit functions of the coordinate displacement parameters. There remains the freedom of Lorentz transformation. The generators of spatial translations and rotations have the correct commutation properties. The question of Lorentz invariance is left undecided since the energy density operator is only given implicitly. (auth)

**18966** APPROACH TO EQUILIBRIUM IN QUANTAL SYSTEMS. II. TIME-DEPENDENT TEMPERATURES AND MAGNETIC RESONANCE. A. Sher (Varian Associates, Palo Alto, Calif.) and H. Primakoff. Phys. Rev., 130: 1267-82(May 1, 1963).

The concept of quasi-equilibrium of the system of interest associated with a time-dependent temperature is introduced and is then applied to a description of the processes of longitudinal and transverse relaxation in magnetic resonance and to a discussion of the law of entropy variation. Systems of interest of size comparable to their surroundings are consistently included in the treatment. (auth)

**18967** FILAMENTARY STRUCTURE IN SUPERCONDUCTORS. E. Maxwell and Myron Strongin (Massachusetts Inst. of Tech., Lexington). Phys. Rev. Letters, 10: 212-15 (Mar. 15, 1963).

Zero-field transitions in superconductors are studied by means of a complex a-c susceptibility, and evidence is observed for the development and growth of a physical filamentary or Mendelssohn sponge network as the temperature is decreased. The real and imaginary parts of the magnetic susceptibility are measured in a cylindrical sample of pure tin in a weak alternating magnetic field as the temperature is lowered through the transition. The temperature variation of the imaginary component follows one of two characteristic patterns. One pattern appears to be intrinsically associated with ordinary bulk superconductors and the other with superconductors having a filamentary superstructure. (C.E.S.)

**18968** STRUCTURE IN THE DENSITY OF STATES OF SUPERCONDUCTING INDIUM FILMS. J. G. Adler and J. S. Rogers (Univ. of Alberta, Edmonton). Phys. Rev. Letters, 10: 217-18(Mar. 15, 1963).

The conductance vs voltage curve for indium was obtained from tunneling experiments with In–$Al_2O_3$–Al junctions. The relative conductance was derived from measurements at temperatures where the indium, but not the aluminum, was superconducting, along with similar measurements at 4°K, where both metals were normal. A better understanding of the factors affecting the density of electron states in a superconductor is required in order to explain the observed effect in indium. (C.E.S.)

**18969** THERMAL CONDUCTIVITY AND ELECTRON SCATTERING AT INTERPHASE BOUNDARIES IN A SUPERCONDUCTOR. S. Straessler (Eidgenössische Technische Hochschule, Zurich). Phys. Rev. Letters, 10: 225-7 (Mar. 15, 1963).

A calculation, based on the additional scattering of electrons in the intermediate state, to explain the maximum in which electrons dominate the thermal conductivity in both the normal and superconductive states is given. An additional condition, that the electronic mean free path in the normal state is longer than the scale of the intermediate state structure, is imposed. Measurements on very pure indium specimens in which these conditions hold are given, and very good agreement with the predictions of the model is found. (C.E.S.)

**18970** DE HAAS-VAN ALPHEN EFFECT AND INTERNAL FIELD IN IRON. J. R. Anderson and A. V. Gold (Ames Lab., Ames, Iowa). Phys. Rev. Letters, 10: 227-9(Mar. 15, 1963). (IS-604)

The discovery of long-period deHaas-van Alphen oscillations in iron is reported. Speculation that there might be some intrinsic reason whereby the existence of ferromagnetism would inhibit the effect was ended. The iron single crystals were "whiskers" of 8-mm length and 0.1 mm thickness. The de Haas-van Alphen oscillations were observed between 1 and 2°K, using the impulsive-field technique under resonance conditions, with the whiskers oriented parallel to the field. Results obtained suggest that the usual theory of the de Haas-van Alphen effect can be applied to conduction electrons in a ferromagnetic metal when the applied field is replaced by the total field. (C.E.S.)

**18971** PROBABLE OBSERVATION OF THE JOSEPHSON SUPERCONDUCTING TUNNELING EFFECT. P. W. Anderson and J. M. Rowell (Bell Telephone Labs., Murray Hill, N. J.). Phys. Rev. Letters, 10: 230-2(Mar. 15, 1963).

An anomalous d-c tunneling current at or near zero voltage was observed in very thin tin oxide barriers between superconducting Sn and Pb that cannot be ascribed to superconducting leakage paths across the barrier and that behaves in several respects like the Josephson current. (C.E.S.)

**18972** HIGH-POWER EFFECTS IN FERRITE DEVICES. P. E. Seiden (Lockheed Missiles and Space Div., Palo Alto, Calif. and Stanford Univ., Calif.) and H. J. Shaw. Proc. I.R.E. (Inst. Radio Engrs.), 48: 1p(Jan. 1960).

The Suhl threshold for the onset of the decrease in susceptibility under conditions of resonance is given by $h_c = \Delta H\sqrt{\Delta H_K/4\pi M_s}$, where $h_c$ is the rf field across the sample, $\Delta H$ the linewidth of the sample, $4\pi M_s$ the saturation magnetization of the sample, and $\Delta H_K$ the linewidth of the spin wave that goes unstable. The profile linewidth and Suhl threshold were measured for a number of samples of ferrite. The spinwave linewidth was calculated. The value for $\Delta H_K$ fell between 0.3 and 4 oersteds for all samples. In the case of the main resonance the decline in susceptibility after Suhl threshold is very slow. (M.C.G.)

**18973** AN ATTEMPT TO DETECT THE POSITRONIUM LYMAN ALPHA SPECTRAL LINE. B. G. Duff and F. F. Heymann (University Coll., London). Proc. Roy. Soc. (London), Ser. A, 272: 363-70(Mar. 19, 1963).

The possibility of optical radiation from the 2p states of positronium is discussed, and an experimental attempt to detect the positronium Lyman $\alpha$ line is described. Photomultipliers are used in the attempted detection. Initially filters, and later a quartz monochromator, are employed as the dispersive elements. Positrons from a radioactive source are stopped in various inert gases, and the total optical signal is recorded by counting circuitry with an automatic system that eliminates background and sensitivity variations. It is estimated that 1 in 1000 of the positrons stop in the gas and give rise to a Lyman $\alpha$ emission, then a signal would be obtained that would be about four times the observed standard deviation in the background counting rate. This peak is not observed, although light from excitation of the target gas is detected. Possible reasons for these negative results are examined. (auth)

**18974** SPIN PARAMAGNETISM OF AN ELECTRON GAS IN A LATTICE OF POSITIVE CHARGES. Ryuzo Abe (Tokyo Univ.). Progr. Theoret. Phys. (Kyoto), 29: 23-8(Jan. 1963). (In English)

The spin paramagnetism of an electron gas in a lattice

of positive charges is studied. The results are compared with theoretical results and experimental data on Li and Na. (auth)

**18975** VARIABLE-PATH MAGNETIC ION BUNCHER. R. C. Mobley (Louisiana State Univ., Baton Rouge). Rev. Sci. Instr., 34: 256-64(Mar. 1963).

Following a previously proposed method for producing short intense monoenergetic ion bunches, a complete variable-path magnetic ion buncher was constructed. Tests in 1958 showed that bunching did occur, but available ion beam intensity and instrumental resolution were too low for detailed measurements at that time. Reconstruction of the available accelerator to give a high current ($\geq 100$ $\mu$a), well-focused ion beam, and correspondingly high resolution pulse measuring equipment permitted meaningful resumption of testing by late 1960. Bunching performance in accordance with design predictions was then observed. Measurements with $^1/_2$-Mev protons indicated pulse lengths $\leq 4$ m$\mu$sec, peak currents $\geq 4$ ma, and a bunching ratio of $\geq 40$. Average bunched current was $>30$ $\mu$a. Although tested with $^1/_2$-Mev protons, the design permits operation with protons or deuterons to more than 1 Mev. Bunching is accomplished by deflecting successive portions of a continuous monoenergetic ion beam from an electrostatic accelerator over progressively shorter paths between foci of a multifocusing 103° deflection magnet in a manner such that all ions come together essentially simultaneously at one focal point in high intensity short duration ion pulses. Sinusoidal electrostatic deflection at 8.8 Mc, linearized by cylindrical electrostatic lenses, or through harmonic synthesis, provides the required sweep. (auth)

**18976** DESIGN OF LOW VOLTAGE ELECTRON GUNS. J. Arol Simpson and C. E. Kuyatt (National Bureau of Standards, Washington, D. C.). Rev. Sci. Inst., 34: 265-8(Mar. 1963).

It is shown that by use of a multistage technique in which electrons are drawn from a cathode by a high potential and decelerated to the required final energy, guns can be designed capable of forming beams in which the current is limited only by space charge in the beam itself. The design principles and procedures are given and illustrated by two examples of electron guns giving highly collimated beams and operating at energies of 30 and 500 ev. The measured currents obtained are somewhat greater than the space charge-limited beam maximum because of ion neutralization. (auth)

**18977** STABILIZATION AND CONTROL OF dc MAGNETIC FIELDS WITH SUPERCONDUCTING SOLENOIDS. Simon Foner (Massachusetts Inst. of Tech., Cambridge). Rev. Sci. Instr., 34: 293-5(Mar. 1963).

The characteristics of solenoid structures are discussed with respect to cancellation of magnetic flux changes. Control of the stabilized field can be effected by using a small secondary solenoid at one end of the main solenoid. Experiments which confirm the expectations are described. (D.L.C.)

**18978** REMANENT MAGNETIC FIELDS IN Nb–Zr SUPERCONDUCTING SOLENOIDS. A. C. Anderson and R. J. Sarwinski (Univ. of Illinois, Urbana). Rev. Sci. Instr., 34: 298-9(Mar. 1963). (TID-17390)

Measurements are reported on the remanent fields in commercial 15,000-G Nb–Zr solenoids at liquid-helium temperatures. The remanent field was in the form of a small positive peak near the center and a large negative peak at the end, and it "saturated" for magnetizing currents greater than 8 to 9 amp. The effects of heating and field changes on the remanent field were studied. (D.L.C.)

**18979** THE PHYSICS OF HIGH-FIELD SUPERCONDUCTORS. Charles P. Bean and Roland W. Schmitt (General Electric Co., Schenectady, N. Y.). Science, 140: 26-35 (Apr. 5, 1963).

Effort in the area of high-field superconductors has led to the construction of 70,000-oersted coils and the expectation that 100,000-oersted fields will be attained. Theory and experiment suggest that the upper critical field of materials such as $Nb_3Sn$ and $Nb_{0.75}Zr_{0.25}$ is determined by their tendency to form a mixed state, and that a crucial question concerning their other properties is that of the interaction of this mixed state with imperfections. It is shown to be possible to make a synthetic high-field superconductor by mechanically subdividing an ideal superconductor. Materials and coils, ideal superconductors, penetration and dimensions, models and model materials, and real materials are discussed. (M.C.G.)

**18980** SUPERCONDUCTING INDIUM ANTIMONIDE. S. Geller, D. B. McWhan, and G. W. Hull, Jr. (Bell Telephone Labs., Murray Hill, N. J.). Science, 140: 62-3 (Apr. 5, 1963).

Attempts to obtain the metallic phase of InSb by the use of a Teflon cell and a 40-centistroke silicone oil as the pressure cell and transmitting medium respectively, in a piston-cylinder apparatus failed. Work done at the University of California, Los Angeles, indicated that the metallic form of InSb could be recovered at liquid-nitrogen temperatures. Therefore, an opposed-anvil apparatus was made from hardened tool steel. The cell had a retaining ring of isomica 0.016-in. thick with an outside diameter of $^1/_2$ in. and an inside diameter of $^3/_{16}$ in. The sample cell had a silver chloride disk 0.012-in. thick. The InSb sample itself was 0.012 in. thick by $^3/_{32}$ or $^3/_{16}$ in. in diameter. As the transition temperature is sluggish under quasi-hydrostatic conditions, the samples were kept above the transition pressure for 3 to 4 days. Then liquid nitrogen was added to the beaker and the pressure released. This sample was superconducting at $2.1 \pm 0.2$°K. (M.C.G.)

**18981** NUCLEAR RESONANCE FLUORESCENCE OF THE 113-Kev LEVEL OF $Hf^{177}$. Werner Wiedemann (Bayerischen Akademie der Wissenschaften, Munich), Paul Kienle, and Friedrich Stanek. Z. Angew. Phys., 15: 7-13 (Jan. 1963). (In German)

The nuclear resonance absorption of the 113-kev $\gamma$ rays of $Hf^{177}$ was studied by utilizing the phenomena of recoilless emission and absorption of $\gamma$ rays from nuclei bound in a crystal lattice. Measurements of the resonance absorption as a function of a Doppler shift for various source and absorber combinations yield a line width for the 113-kev $\gamma$ transition of $(1.06 \pm 0.1) \times 10^{-6}$ ev, corresponding to a mean life time of $\tau = (6.2 \pm 0.6) \times 10^{-10}$ sec for the 113-kev state in $Hf^{177}$. Debye-temperatures of $(204 \pm 20)$°K for Lu $(176 \pm 10)$°K for Hf, $(313 \pm 10)$°K for $Lu_2O_3$, and $(226 \pm 10)$°K for $HfO_2$ are deduced from the observed fraction of recoilless processes at 20°K. (auth)

**18982** MEASUREMENT OF 2P-1S-TRANSITION ENERGY IN MUON-BARIUM ATOM. D. Quitmann (Technische Hochschule, Darmstadt, Ger.). Z. Physik, 172: 263-78(1963). (In German)

As a means of studying the nuclear charge radius, the 2P–1S-transition energy of the muon-barium-atom ($\mu$-mesonic $K_\alpha$-line) was measured. A 3" × 3" NaI-spectrometer was used at the muon channel of the CERN-synchrocyclotron. Since the muon intensity was high, measurements could be repeated under various conditions. Experiment, checks, and results are described. The 2P–1S-energy obtained, (3981 ± 30) kev, agrees with the value calculated by

Ford and Wills (3974 kev) for a "family II"-charge distribution fitted to the Stanford electron scattering data. (auth)

**18983** SURFACE TENSION OF $He^3-He^4$ SOLUTIONS. B. N. Esel'son, V. G. Ivantsov, and A. D. Shvets. Zh. Eksperim. i Teor. Fiz., 44: 483-6(Feb. 1963). (In Russian)

The surface tension ($\alpha$) of liquid mixtures of helium isotopes containing 9.5, 15.0, 19.0, 50.0, and 75.7% $He^3$ is measured in the 1.3 to 4.2°K temperature range. The magnitude of $\alpha$ gradually decreases with increase of the $He^3$ content, the values being lower than those that could be expected on the assumption of additivity. The results are compared with the conclusions of theory. (auth)

**18984** CALCULATION OF THE CROSS SECTION FOR ELECTRON LOSS BY FAST IONS IN LIGHT MEDIA. I. S. Dmitriev and V. S. Nikolaev (Nikolayev) (Moscow State Univ.). Zh. Eksperim. i Teor. Fiz., 44: 660-5(Feb. 1963). (In Russian)

The effective cross sections for loss of electrons by fast ions in hydrogen and helium are calculated in the free-collision approximation. If the binding energy of the lost electron is low, screening of the Coulomb field of the atomic nuclei of the medium primarily determines the magnitude of the cross section. In such cases, and for high velocities, the free collision approximation yields results that are the same as those obtained in the Born approximation. (auth)

**18985** PROPAGATION OF WAVES IN A MEDIUM WITH STRONG FLUCTUATIONS OF THE REFRACTIVE INDEX. V. I. Tatarskii (Tatarsky) and M. E. Gertsenshtein (Inst. of Atmospheric Physics, Academy of Sciences, USSR). Zh. Eksperim. i Teor. Fiz., 44: 676-85(Feb. 1963). (In Russian)

The Green function for an infinite medium with strong small-scale fluctuations of the refractive index is determined. The solution is derived in manner similar to the renormalization method in field theory. An expression for the effective refractive index of the medium and attenuation coefficient is deduced. (auth)

**18986** TEMPERATURE DEPENDENCE OF THE GAP IN A SUPERCONDUCTOR. E. G. Batyev (Batiyev) (Inst. of Radiophysics and Electronics, Siberian Branch, Academy of Sciences, USSR). Zh. Eksperim. i Teor. Fiz., 44: 710-16(Feb. 1963). (In Russian)

It is shown that the temperature dependence of the energy gap in superconductivity theory is valid without the assumption being made that the interaction is weak, providing the gap is small compared with the Debye frequency. (auth)

**18987** THE ANGULAR DISTRIBUTION OF SECONDARY ELECTRONS PRODUCED BY RARE GAS IONS IN THE ENERGY RANGE 300-4000 ev IN PURE AND GAS COVERED TUNGSTEN SURFACES. Hans Joachim Klein. Thesis, Cologne, Universität, 1961. 51p. $2.00; 8 DM.

The angular distribution of secondary electrons produced by field and kinetic emission in tungsten is studied under equal conditions for $He^+$, $Ne^+$, and $Ar^+$ ions. The high vacuum apparatus for measurements with pure target surfaces is described. For the kinetic emission of electrons a cosine distribution was observed in all cases. This indicates an isotopic distribution in the metal. These results are in agreement with theoretical predictions. Potential emission gives a slight enhancement in the normal direction indicating a non-isotopic production in the metal. A possible explanation of this effect is an additional plasma excitation by secondary electrons. (Gmelin Inst.)

**18988** MEASUREMENTS OF THE INTENSITY DISTRIBUTION OF ELASTICALLY AND INELASTICALLY SCATTERED ELECTRONS IN DEBYE-SCHERRER DIAGRAMS OF THIN SILVER FOILS. Norbert Wedel. Thesis, Nuremburg, Universität, 1961. 51p. $2.00; 8 DM.

The methods for the production of polycrystalline silver foils are described. The Debye-Scherrer diagram of these foils were measured with an inverse field arrangement that permitted the separation of inelastically scattered electrons. The measured values of the relative intensities cannot be explained by the kinematic theory for lattice constants between 40 and 80 Å and acceleration potentials of 20-50 kv. The dependence of the intensity on the wave length and the lattice constants indicates the presence of dynamic effects. Dynamic effects can be explained in a qualitative way by postulating a size distribution of elementary cells in the foil. The quotients of the relative ring intensities for unfiltered and filtered diagrams are constant. The absolute intensities were determined. Nearly 50 percent of the intensity is scattered into an angle that is smaller than 0.15 radians. (Gmelin Inst.)

**18989** LIGHT WATER LATTICES. Report of the Panel on Light Water Lattices held in Vienna, 28 May-1 June 1962. (International Atomic Energy Agency, Vienna). Technical Reports Series No. 12. Nov. 1962. 369p. STI/DOC/10/12

A total of thirteen papers are presented along with short summaries of discussions and program status in the U. S., France, and U. K. Three of the papers were previously abstracted in NSA. Separate abstracts were prepared for ten of the papers. (J.R.D.)

**18990** A SUMMARY AND PRELIMINARY ANALYSIS OF THE BNL SLIGHTLY ENRICHED URANIUM, WATER MODERATED LATTICE MEASUREMENTS. R. L. Hellens and H. C. Honeck (Brookhaven National Lab., Upton, N. Y.). p.27-71 of "Light Water Lattices." Vienna, International Atomic Energy Agency, 1962. (In English)

The measurements carried out at BNL in 96 light water moderated, U-metal-fueled reactor lattices are summarized. These results are used to evaluate the capability of a variety of theoretical methods to predict the neutron behavior in the lattices as indicated by the material buckling and lattice parameters. Particular attention is given to the fast effect, resonance capture, and thermal neutron distribution. (auth)

**18991** SOME LIGHT WATER LATTICE EXPERIMENTS IN THE UNITED KINGDOM. I. Johnstone (Atomic Energy Establishment, Winfrith, Dorchester, Eng.). p.73-97 of "Light Water Lattices." Vienna, International Atomic Energy Agency, 1962. (In English)

Critical and exponential measurements were made in a number of light water moderated lattices, fueled with highly enriched U. The results are compared with theoretical predictions based on the MUFT-SOFOCATE few-group model and shown to be in good agreement. Further work is reported on an experimental comparison between U-water and Pu-water lattices which may point to a breakdown in the methods of calculation or to a discrepancy in the nuclear data in current use for Pu. (auth)

**18992** LIGHT WATER LATTICE CALCULATIONS IN THE UNITED KINGDOM. D. Hicks (Atomic Energy Establishment, Winfrith, Dorchester, Eng.). p.99-131 of "Light Water Lattices." Vienna, International Atomic Energy Agency, 1962. (AEEW-R-174). (In English)

United Kingdom calculations for light water lattices were based on the MUFT-SOFOCATE few-group model. A complex analytical scheme based on the use of several computer programs was built up which accounts satisfactorily for the behavior of a number of United Kingdom and United States lattices. This scheme was superseded for many

purposes by the comprehensive Sandpiper I and II computer codes developed at Winfrith. These were incorporated in the Redshank-Greenshank burn-up codes which gave the typical results which are included. The work described forms part of a wider program covering the whole field of light and heavy water moderation. (auth)

**18993** ANALYSIS OF EXPERIMENTS CARRIED OUT IN ALIZÉ I. J. Bailly, R. Delayre, Y. Girard, C. Guionnet, and C. Pontis (Commissariat a l'Énergie Atomique, Centre d'Études Nucléaires, Saclay, France). p.133-54 of "Light Water Lattices." Vienna, International Atomic Energy Agency, 1962. (In French)

Alizé I experiments with a light water – 1.5 wt % $UO_2$ lattice were mainly devoted to the study of absorbing plates (Ag, In, Cd, and B). An attempt was made to get some information on epithermal absorption, taking displaced volume and surrounding water gaps into account. Analysis of results leads to empirical parameters, but other experiments are needed to extend the validity range of spectrum and geometry. (auth)

**18994** TECHNICAL PROBLEMS IN USING WATER SYSTEMS. J. Bailly and Y. Girard (Commissariat a l'Énergie Atomique, Centre d'Études Nucléaires, Saclay, France). p.155-65 of "Light Water Lattices." Vienna, International Atomic Energy Agency, 1962. (In French)

Two technical problems encountered in light-water critical experiments are considered. The first concerns the exact level of water in very tight lattices and the second concerns the best conditions for using borated solutions in order to obtain very high accuracy. (auth)

**18995** ANALYSIS OF LIGHT-WATER, HIGHLY-ENRICHED URANIUM LATTICES, WITH AND WITHOUT HAFNIUM, TESTED IN THE ALIZÉ II INSTALLATION. J. Bailly, R. Delayre, Y. Desesquelles, Y. Girad, and C. Guionnet (Commissariat a l'Énergie Atomique, Centre d'Études Nucléaires, Saclay, France). p.167-75 of "Light Water Lattices." Vienna, International Atomic Energy Agency, 1962. (In French)

The extent to which the reactivity of cores uniformly loaded with natural Hf may be calculated is evaluated. Two series of critical lattices are used; in one lattice Al is employed alone, while in the other, Zircaloy plates are used instead of those made of Al. (J.R.D.)

**18996** THE CALCULATION OF THE THERMAL UTILIZATION AND DISADVANTAGE FACTOR IN URANIUM WATER LATTICES. H. C. Honeck (Brookhaven National Lab., Upton, N. Y.). p.233-65 of "Light Water Lattices." Vienna, International Atomic Energy Agency, 1962. (In English)

The theoretical methods for computing intracell thermal neutron densities, disadvantage factors, and thermal utilizations which were developed at the Brookhaven National Laboratory are reviewed. The topics discussed include computation of the neutron spectra in a lattice, anisotropic scattering by water, the cylindrical cell effect, correlation of spectral moments and average one-group cross-sections, one-group transport theory methods, scattering models of water, and comparison of various theories with experiment. The lattices investigated are water moderated with slightly enriched U metal and U oxide fuel. (auth)

**18997** MULTI-REGION LATTICE STUDIES: CORRELATION OF THEORY AND EXPERIMENT. G. H. Minton (Westinghouse Electric Corp., Pittsburgh). p.285-301 of "Light Water Lattices." Vienna, International Atomic Energy Agency, 1962. (In English)

The research and development programs at Westinghouse Atomic Power Division have emphasized the utilization of machine methods of computation and the evaluation of such methods by means of interpretation of critical experiments. The most recent program of critical experiments was the Multi-region Lattice Studies carried out under the Fuel Cycle Development Program. This program involved the measurements of criticality, neutron flux distribution, and reaction rates (microscopic parameters) in lattices of light water moderated, low enriched, $UO_2$ fuel clad in stainless steel. Fuel rods of $UO_2$ enriched to 1.6%, 2.7%, and 3.7% were utilized in lattices of 2.5 : 1 and 4.5 : 1 water/U ratio. Currently, these experiments are being supplemented by measurements in the same lattices with boric acid dissolved in the moderator. The present status of a number of experimental and analytical problems is summarized and areas where further effort is needed are noted. An attempt is made to point out inter-relationships between different measurements or calculations where significant points of agreement or contradiction can be useful in interpretation of results or in planning future work. (auth)

**18998** PHYSICS CHARACTERISTICS OF SEED-BLANKET LATTICES. A. Radkowsky (Division of Reactor Development, AEC). p.303-48 of "Light Water Lattices." Vienna, International Atomic Energy Agency, 1962. (In English)

Seed-blanket core arrangements consisting of a natural U blanket driven by a highly enriched seed, as exemplified in the Shippingport cores, present a type of light water lattice which is very interesting physics wise and is also of great practical importance as a promising approach to economic nuclear power. Areas of major physics interest include those related to the phenomena at the boundary between the seed and the blanket in which the neutron flux and spectra are changing rapidly; the control characteristics of such an arrangement – the reactor tends to have the control properties of a small highly enriched core; and the depletion characteristics – by replacing seeds it is possible to drive the blanket to the radiation limit of the materials, estimated to be about 30000 Mwd/t average for uranium oxide fuel. Most of the energy in the blanket at this time will have come from burning Pu. The physics characteristics of the Shippingport cores, both initially and throughout life, and the parameter measurements in the critical assemblies are presented and compared with calculations. (auth)

**18999** BOILING LIGHT WATER REACTOR PHYSICS. T. M. Snyder (General Electric Co., San Jose, Calif.). p.349-63 of "Light Water Lattices." Vienna, International Atomic Energy Agency, 1962. (In English)

Discussions are presented concerning boiling reactor physics. Included are discussions of lattice physics methods, treatment of clumped fuel rods, experimental justification of the clumped treatment, and analysis of axial variations in lattice composition. (J.R.D.)

**19000** LE PROBLÈME A N CORPS. PROPÉRTIÉS GENERALES DES GAZ DE FERMIONS. (The N Body Problem. General Properties of a Fermion Gas). P. Nozières. Paris, Dunod, 1963. 329p.

The general properties of infinite systems of fermions at zero temperature are considered. The object is to analyze the correlation mechanism and to set up a solid formalism which can be directly generalized to more complex cases. The Landau theory of "normal" Fermi liquids is first discussed. This phenomenological introduction isolates the most important concepts. The response of the system to external excitations such as an exterior field and scattering

of a beam of incident particles is then considered. The Green functions are then formally introduced. The physical sense of these functions is discussed, first for "normal" systems and then for "superfluid" systems. The perturbations techniques are introduced, and their utilization is illustrated. These methods are generalized to superfluid systems. (J.S.R.)

## Astrophysics and Cosmology

*Refer also to abstract 17650.*

**19001** (TID-16599) ABUNDANCES OF RUTHENIUM, OSMIUM AND URANIUM IN SOME COSMIC AND TERRESTRIAL SOURCES. George L. Bate and J. R. Huizenga (Argonne National Lab., Ill.). June 1962. Contract W-31-109-Eng-38. 34p. (UAC-6583)

Determinations of ruthenium and osmium in ten chondrites by neutron activation analysis give average concentrations of $0.89 \times 10^{-6}$ g Ru/g meteorite and $0.91 \times 10^{-6}$ g Os/g meteorite. With proper assumptions these values lead in turn to cosmic abundances (per $10^6$ Si atoms) of 1.3 for Ru and 0.73 for Os. The averages cited include Ru and Os concentrations for a carbonaceous chondrite, which, though below average, fall within the range of concentrations found for the non-carbonaceous chondrites. The range in both the Ru and Os concentrations from about $0.6 \times 10^{-6}$ to $1.4 \times 10^{-6}$ g/g reflects not only the variable amount of metal content in the chondrites, but also the variation in Ru and Os concentrations in the metal phase. Analyses of the separated metal and siliceous phases of two chondrites show a marked enrichment of Ru and Os in the metal phase, and they further show that significant amounts of these elements are present in the siliceous phase. Ruthenium and osmium concentrations in Canyon Diablo troilite are found to be suppressed ~ two orders of magnitude to attribute the presence of Ru and Os in the siliceous phase of chondrites to sulfide inclusion. The isotopic ratio Os-814/Os-190 for osmium in meteorites agrees with that in terrestrial material to ~1%, within the limits of experimental error. The agreement of Ru-96/Ru-102 for ruthenium in meteoritic and terrestrial sources is ~2–3%. Uranium concentrations are reported for a few samples including the standard rocks G-1 and W-1. Two achondrites, a tektite, and several terrestrial samples contained ruthenium and osmium concentrations 2–3 orders of magnitude below those in chondrites, giving evidence of the marked depletion of these elements in differentiated silicate matter. (auth)

**19002** HELIUM-BURNING REACTION PRODUCTS AND THE RATE OF ENERGY GENERATION. H. L. Duorah and R. S. Kushwaha (Univ. of Delhi). Astrophys. J., 137: 566-71(Feb. 15, 1963).

Products of helium-burning reactions in stars are examined with recent observational data, keeping the pure helium-star model in mind. $O^{16}$, which remains the principal product of helium-burning at lower temperature ($T_8 \cong 1.2$) and higher density ($\rho x \alpha = 10^4$ g/cc) even when helium is exhausted inside the core, gives place to $Ne^{20}$ at higher temperature ($T_8 = 3$) and lower density ($\rho x \alpha = 10^2$ g/cc). The energy-generation rates are calculated and found to be higher than usual for helium-burning reactions. However, this higher rate of energy production is found not to have any appreciable effect on the physical parameters, such as the central temperature of the He-star models. (auth)

**19003** SPECTRAL CHARACTERISTICS OF SOLAR CONTINUUM RADIATION IN THE 500–1000 MC/S RANGE. M. R. Kundu (Univ. of Michigan, Ann Arbor) and C. L. Spencer. Astrophys. J., 137: 572-9(Feb. 15, 1963).

The spectral characteristics of flare-associated continuum radiation in the 500 to 1000 Mc range are described. The continuum radiation in this frequency range consists of a smooth background continuum and different variabilities superimposed upon it. The superimposing variabilities are mostly in the form of fine structure fast-drift bursts; however, occasionally they appear in the form of "sprays" or patchiness. The meter-λ type IV continuum radiation is always associated with a dcm-λ burst of continuum radiation. The dcm-λ continuum starts almost simultaneously with the concurrent cm-λ continuum; also, its maxima sometimes correspond to the cm-λ maxima. From these and other characteristics (such as source size, height, motion, etc.) of dcm-λ continuum, it is suggested that the dcm-λ continuum, like the concurrent cm-λ continuum, represents the first phase of type IV radiation as a whole. Only a small fraction of meter-λ bursts of spectral types II and V are associated with dcm-λ bursts. The type II associated dcm-λ bursts are mostly of continuum type, although fast-drift elements may sometimes be superimposed on the continuum. The type V associated dcm-λ bursts are mostly of "generalized fast-drift" type. (auth)

**19004** SPECTRUM OF THE FLARE OF SEPTEMBER 2, 1960. Elske v. P. Smith (Sacramento Peak Observatory, [Calif.] and Harvard Univ., Cambridge, Mass.). Astrophys. J., 137: 580-91(Feb. 15, 1963).

Several spectrograms were obtained during the development, including the flash phase, of the flare of September 2, 1960. The attempt to interpret the profiles in terms of a flare-jet model was not successful. The line profiles did, however, satisfy the same macroscopic velocity model suggested for the September 18, 1957, flare, which this flare closely resembled. The Balmer lines, He I $D_3$, and H and K of Ca II were all exceedingly bright and wide at the flash phase. The observations seemed to require a source function increasing with height in the flare, at least to the extent that there was a high-excitation surface region. (auth)

**19005** SPECTROSCOPIC LIMITATION ON CORONAL HEATING MECHANISMS. Donald E. Billings (High Altitude Observatory, Boulder, Colo.). Astrophys. J., 137: 592-600(Feb. 15, 1963).

Spectroscopic observations of the corona have implications concerning its heating mechanism. Specifically, the very small amount of gross Doppler shifts in coronal lines limits severely the types of disturbances that may be postulated to heat the corona. (auth)

**19006** THE 7.66 Mev STATE OF $C^{12}$ AND HELIUM-BURNING. P. A. Seeger and R. W. Kavanagh (California Inst. of Tech., Pasadena). Astrophys. J., 137: 704-6 (Feb. 15, 1963).

The reaction rate of the 7.66-Mev state of $C^{12}$ ($C^{12*}$) in He-burning stars is calculated from measured values of the radiative width of the level and of the mass difference ($C^{12*} - 3He^4$). The uncertainty in the calculated reaction rate is about 60%. (T.F.H.)

**19007** INITIAL STAGES IN THE EVOLUTION OF THE UNIVERSE. Ya. B. Zel'dovich. At. Energ. (USSR), 14: 92-9(Jan. 1963). (In Russian)

The theory of the expanding universe is the cosmological theory based on firmly established laboratory data. The theory presupposes that at a certain time the density of the matter was infinitely great, attempting to determine the velocity distribution at which the velocity of the relative motion of each pair of particles is proportional to the distance between the particles. The particles tend to increase

this distance, causing a universal expansion of the matter. According to G. Gamov, in its initial stages, the matter was at an extremely high temperature. Under these conditions, the radiation density, i.e., the light or x-ray quanta, exceeded the nuclear density. Instead of the above, a theory is presented, assuming that the matter consisted of a cold mixture of protons, electrons, and neutrinos. At high densities, various processes, such as formation of hyperons and the partial transformation of protons into neutrons may take place. When, during the expansion, the nuclear density is reached, the composition is in equilibrium. The theory leads to the conclusion that the first generation of stars in the first stages of their evolution consists of pure hydrogen. (TTT)

**19008** COSMIC NUMBERS. E. R. Harrison (Rutherford High Energy Lab., Chilton, Berks, Eng.). Nature, 197: 1257-9(Mar. 30, 1963).

Cosmic numbers are discussed as suggesting a close connection between the separate domains of atomic or nuclear physics and cosmology. The characteristic radius of the universe expressed in terms of the classical electron radius is similar in value to the force ratio of the Coulomb and gravitational forces between electron and proton. A range of cosmic numbers with hierarchical structure is constructed based on cosmological and nuclear constants. The question of antisymmetry in atomic and cosmic interactions is considered. When applied to various cosmological models the cosmic numbers are shown to have various consequences and to narrow down considerably the number of possible cosmological models. (C.E.S.)

**19009** THERMONUCLEAR REACTIONS IN STARS INVOLVING HEAVY IONS UP TO THE FORMATION OF IRON NUCLEI. Hiroshi Tsuda (Kyoto Univ.). Progr. Theoret. Phys. (Kyoto), 29: 29-43(Jan. 1963). (In English)

With an increase of temperature in a stellar core in which helium is consumed completely, various thermonuclear reactions occur successively: $C^{12} + C^{12}$ reactions occur at $6 \times 10^{8}$°K; $Ne^{20}(\gamma,\alpha)O^{16}$ reactions occur at $1.0 \times 10^{9}$°K; and $O^{16} + O^{16}$ reactions occur at $1.25 \times 10^{9}$°K. These reactions are accompanied by production and absorption of protons and $\alpha$ particles, and various elements are synthesized. In the cases of $C^{12} + C^{12}$ and $O^{16} + O^{16}$ reactions, neutrons are also produced. If the stellar core is rich in carbon after helium burning, a considerable amount of heavy metals is produced, but if the core is rich in oxygen, heavy metals are scarcely produced. The elements remaining after oxygen burning are $Mg^{24}$, $Mg^{25}$, $Si^{28}$, $P^{31}$, etc., if carbon is abundant initially, and $Si^{28}$, $P^{31}$, $S^{32}$, etc., if oxygen is abundant. Reactions next arising are $Mg^{25}(\gamma,n)$, $P^{31}(\gamma,p)$, $S^{32}(\gamma,p)$, $S^{32}(\gamma,\alpha)$, etc., at $1.5 \times 10^{9}$°K. Further, $Mg^{24}$ and $Si^{28}$ are disintegrated at $2 \times 10^{9}$°K and then thermal equilibrium will be established for the concentrations of the disintegration products. (auth)

## Cosmic Radiation

*Refer also to abstracts 18355, 18356, 18357, 18358, 18359, 18360, 18361, 18385, 18386, and 18387.*

**19010** (AD-284490) TIME PATTERN OF IONIZING RADIATION IN BALLOON ALTITUDES IN HIGH LATITUDES. Final Report. Georg Pfotzer, Alfred Ehmert, and Erhard Keppler (Max-Planck-Institut für Aeronomie. Institut für Stratosphärenphysik, Lindau/Harz, Germany). Aug. 1, 1962. Contract AF61(052)-372. 62p.

Part B, Figures. For Part A, Text, see AD-284488.

Details of the ionization chamber and of the coincidence and single counters used in balloon studies of the time pattern of ionizing radiation at high latitudes are presented. Data taken by the three techniques are displayed graphically along with results of riometer measurements and magnetic field measurements. (D.C.W.)

**19011** (AFCRL-63-242) VARIATIONS IN THE COSMIC-RAY NUCLEONIC INTENSITY. Final Report. J. A. Lockwood (New Hampshire. Univ., Durham). Jan. 1, 1963. Contract AF 19(604)-4552. 81p.

Certain features of the temporal variations of the cosmic neutron intensity were analyzed and the neutron and charged particle intensities were measured at distances of 200-500 km from the earth. The investigation of the intensity-time variations is divided into four areas: the long-term or 11-year variation, Forbush decreases, 27-day recurrent tendencies, and increases associated with solar flares. The results of measurements of the charged particle and neutron intensities in June and July, 1962, are in a preliminary form. The long-term variation of intensity is interpreted as occurring in several sudden decreases rather than gradually. The largest changes of cosmic-ray intensity and in the ratios of intensities recorded by detectors at different locations on the earth followed the occurrences of large Forbush decreases. Frequency distributions of the changes in nucleonic intensity from day to day show the importance of the Forbush decreases to the long-term variation. Data are presented on the current recovery phase of the long-term cycle (1958-1962). The investigation of the Forbush decreases that occurred from 1954 to 1960 utilized data from the world-wide IGY network of cosmic-ray stations. The changes in the primary rigidity spectrum, any significant differences in onset times, existence of anisotropies during the main phase of the decrease, and the time order of the Forbush decreases and geomagnetic storms were determined. The long-term variation is adequately described by a modulation of the primary spectrum given by $1 - C(t)P^{-1}$, where $1 \leq C(t) \leq 2.5$, and $C(t)$ is a function of time during the solar cycle. For individual decreases the modulation is $1 - C(t_F)P^{-1} + k_F$, where $0 \leq k_F \leq 4$ per cent, for nucleonic detectors at sea level and mountain elevations, and $0.6 \leq C(t_F) \leq 2.2$. The differences in onset times observed during some events are related to directions in space beyond the geomagnetic field. The onset was always earlier to the west of the earth-sun line, varying from minutes to hours. Where the onset at some stations preceded the geomagnetic storm, the solar plasma cloud responsible for the decrease originated from the western hemisphere of the solar disk. The superposed intensity increases and decreases observed during events are related to directions in space outside the geomagnetic field. The anisotropies recorded as decreased intensities occurred from the west, and those recorded as increases occurred from the east of the earth-sun line. These anisotropies are both short and long lived. Superposed intensity increases occurring simultaneously at all stations were frequently observed. An interpretation of these anisotropies and the differences in onset times are given. The study of the 27-day recurrent variations indicated that the determination of a periodicity is critically dependent upon the particular time interval selected. The periodicity from 1954-1959 varied from 24-39 days, to be attributed partly to large Forbush decreases. Some discussion is presented of the relation of the recurrent tendencies to solar active regions. Several increases in the nucleonic intensity following solar flares occurred between 1958 and 1962. One increase of about 200 per cent at Mt. Washington was recorded approximately 15 minutes after a large

solar flare starting at 1015 UT on May 4, 1960. Two increases of about 100 per cent were recorded at Durham and Mt. Washington on November 12 and 15, 1960, and a third smaller increase was observed on November 20, 1960. These latter increases occurred shortly after 3+ solar flares in region 5925. The rigidity spectrum for the flare-produced particles can be expressed as $KP^{-n}$ with $n = 6$. Considerable particle dispersion was observed for the November 12 event. There is evidence that classical impact zone theory does not apply for the May and November events. Two smaller nucleonic intensity increases were recorded on July 18 and 20, 1961. To evaluate these solar flare effects calculations were made of the trajectories of protons of different rigidities that arrive at Durham and Mt. Washington. The neutron and charged particle intensities were measured at distances of 200-400 km from the earth to determine the cosmic-ray neutron leakage flux. On flights before July 9, 1962, the neutron intensity was $0.15 \pm 0.04/cm^2/sec$ at 400 km altitude and 45°N geomagnetic latitude and $0.010 \pm 0.03$ at the equator at about 200 km. Measurements of the neutron flux after July 9 are not significant for an evaluation of the cosmic-ray albedo flux. The charged particle fluxes after July 9 are complex, the results indicating electron fluxes ($E \geq 1.5$ Mev) of about $10^3/cm^2/sec$ at altitudes of 200-250 km over the South Atlantic and North Pacific and proton fluxes ($50 \leq E \leq 75$ Mev) of about $150/cm^2/sec$ at altitudes of 350 km in the region 0-60° E longitude and >60° S latitude. Dumping of the artificial radiation belt is observed at certain times, not specifically associated with obvious solar or geomagnetic events. 78 references. (auth)

**19012** EXHAUSTION OF GEOMAGNETICALLY TRAPPED RADIATION. Sylvan Rubin and Aryeh H. Samuel (Stanford Research Inst., Menlo Park, Calif.). AIAA (Am. Inst. Aeron. Astronaut.) J., 1: 500(Feb. 1963).

The amount of matter that must be injected into belts of geomagnetically trapped radiation in order to lower the radiation levels is estimated. Two mechanisms are available for this purpose: the elastic scattering of particles into paths that will intersect the atmosphere before mirroring and the removal of the particles' energy by ionization and excitation. (C.E.S.)

**19013** DISPOSITION OF THE INNER RADIATION BELT AND MAGNETIC FIELD OF THE EARTH. E. V. Gorchyakov. AIAA (Am. Inst. Aeron. Astronaut.) J., 1: 520-1(Feb. 1963). (Translated by Andre L. Brichant from Iskusst. Sputniki Zemli, No. 9, 62-5(1961)).

A scintillation counter on Sputnik III was used to conduct ionization measurement in a sodium iodide crystal and register the number of events releasing more than 35 kev in the crystal. The boundary of the inner radiation belt shows a strong longitudinal effect. The observed dependence on longitude of the boundary was explained by the fact that the inner belt consists of particles captured by the geomagnetic field and constitutes a noncentral dipole field. (C.E.S.)

**19014** DOSIMETRIC MEASUREMENTS ON THE SECOND SOVIET SPACESHIP SATELLITE. I. A. Savenko, N. F. Pisarenko, and P. I. Shavrin. AIAA (Am. Inst. Aeron. Astronaut.) J., 1: 526-9(Feb. 1963). (Translated by Andre L. Brichant from Iskusst. Sputniki Zemli, No. 9, 71-7(1961)).

Readings of counters placed inside Sputnik II are given for one portion of its trajectory. The readings were taken by a gas-discharge counter STS-5 and a NaI crystal scintillator counter that registered gamma quanta, charged particles with a 25-kev counting threshold, and the aggregate energy liberation of ionizing radiations in the crystal. (C.E.S.)

**19015** PREDICTING LARGE SOLAR COSMIC RAY EVENTS. Harriet H. Malitson (National Aeronautics and Space Administration, Greenbelt, Md.). Astronaut. Aerospace Eng., 1: 70-3(Mar. 1963).

To meet the needs of manned space programs, the probability of occurrence of a solar cosmic ray event during any specified period of time must be determined. The present prediction capability is presented and results of an attempt to improve the prediction capability are given. Penumbral-area criterion is applied to prediction of solar proton events to indicate possible "safe-periods" from available data for the years 1949 to 1961. A detailed statistical study of the year 1956 is included. Twenty references are cited. (C.E.S.)

**19016** ARTIFICIAL RADIATION BELT STUDIES WITH A FISSION BETA-RAY SOURCE. H. T. Motz and R. E. Carter (Los Alamos Scientific Lab., N. Mex.). J. Geophys. Res., 68: 657-61(Feb. 1, 1963). (LADC-5502)

The magnetic trapping of electrons from recent high-altitude nuclear testing resulted in a flux of high-energy electrons whose spectrum is believed to be quite similar to that from uranium undergoing fission at equilibrium. A reactor facility using a foil under such conditions was assembled to study the response of a Geiger counter to a fission $\beta$ spectrum for various absorbers. This facility was used to measure the fission $\beta$ response of the background counter in an Injun satellite counter assembly, and to measure the pulse-height distribution from a detector similar to that used in the Telstar satellite. (auth)

**19017** INCREASES IN INTENSITY OF SOLAR COSMIC RAYS BEFORE SUDDEN COMMENCEMENTS OF GEOMAGNETIC STORMS. W. I. Axford (Defence Research Board, Ottawa) and G. C. Reid. J. Geophys. Res,, 68: 1793-1803 (Apr. 1, 1963).

On at least three occasions, marked enhancement is observed in the intensity of polar-cap absorption of radio waves before sudden commencement (SC) of a geomagnetic storm. During one of the events, on September 30, 1961, equipment on board the satellites Explorer 12 and Injun 1 confirmed a suggestion that the enhanced absorption is caused by an increase in the flux of low-energy solar cosmic rays. The evidence about the pre-SC enhancements is presented in detail, and the effect is interpreted in terms of a compression of the particles between two shock waves in the interplanetary medium. One of these shock waves, associated with the geomagnetic storm, approaches the earth with a speed of the order of 1000 km/sec, whereas the other is a "standing" shock wave set up by the motion of the solar wind past the magnetosphere. The net effect of the compression is to cause the particles to crowd together and to increase their energy by Fermi acceleration. Both effects tend to increase the flux above a given energy in the vicinity of the earth. It is shown that many of the observed features can be explained by this interpretation. (auth)

**19018** EMULSION MEASUREMENTS OF SOLAR ALPHA PARTICLES AND PROTONS. Phyllis Freier (Univ. of Minnesota, Minneapolis). J. Geophys. Res., 68: 1805-10(Apr. 1, 1963).

Spectra of solar protons and $\alpha$ particles as determined from emulsions are given for the May 10, July 14, and July 16, 1959, flares, and the July 13, and July 18, 1961, flares. These spectra are expressed as exponentials in rigidity. The fluxes are measured at several different times during each flare. The proton to $\alpha$ particle ratio

can be determined at six different times during these five flares. (auth)

**19019** ON THE ENERGY SPECTRUM OF PROTONS TRAPPED IN THE EARTH'S INNER VAN ALLEN ZONE. C. E. McIlwain and G. Pizzella (Univ. of California, San Diego). J. Geophys. Res., 68: 1811-23(Apr. 1, 1963).

The proton energy spectrum in the inner Van Allen zone is investigated in the range 30 to 40 Mev with two Geiger counters aboard the satellite Explorer 4. It is found that an exponential spectrum $dN = I_0 e^{-E/E_0} dE$ is suitable for describing the variation of the "hardness" of the spectrum with the magnetic coordinate L. The present data yield the following variation of $E_0$ with L: $E_0 = (306 \pm 28) L^{-(5.2 \pm 0.2)}$ Mev. An extrapolation of this function also gives the correct order of magnitude for $E_0$ for almost all values of L. It is believed that the relationship determined between $E_0$ and L supports the theory of a breakdown of the adiabatic conditions for the protons trapped in the earth's magnetic field. (auth)

**19020** CALCULATION OF LOW-ENERGY NEUTRON FLUX IN THE ATMOSPHERE BY THE $S_n$ METHOD. L. L. Newkirk (Lockheed Missiles and Space Co., Palo Alto, Calif.). J. Geophys. Res., 68: 1825-33(Apr. 1, 1963).

The transport equation pertaining to cosmic neutrons in the atmosphere was solved for neutron flux by means of the numerical multigroup $S_n$ method. Flux values were obtained at geomagnetic latitude 57°N as a function of altitude and energy group in the range from thermal to 20 Mev. These results, and continuous neutron flux distributions over energy determined from them, were presented for several representative altitudes. On the basis of the fluxes and appropriate neutron cross sections, averaged world rates for production of $C^{14}$ and $H^3$(T) by neutron absorption processes in the atmosphere were calculated to be 2.1 atoms $C^{14}$ $cm^{-2}$ $sec^{-1}$ and 0.07 atom T $cm^{-2}$ $sec^{-1}$. (auth)

**19021** CHANGES IN THE F REGION DURING MAGNETIC STORMS. Y. V. Somayajulu (Pennsylvania State Univ., University Park). J. Geophys. Res., 68: 1899-1922(Apr. 1, 1963).

The F-region changes associated with three severe magnetic storms during the IGY period are studied. The relevant data from Washington (D. C.), Panama, Talara, and Huancayo, which lie approximately along the 75°W meridian, are converted to electron-density-true-height profiles. From the N-h profiles the storm effects are determined and studied. The storm changes indicate that large F-region height variations of the order of 200 km may occur during severe storms. It is shown that changes during given storms can be separated into two parts: one from polar ionospheric currents, and one from current systems well above the ionosphere. These current systems have general features similar to those derived for averages of storms, although several significant departures are observed. It is found that the total electron content up to 200 km is relatively unaffected by storms; the electron content between 200 and 300 km and the subpeak electron content are, in general, found to decrease during strong storms from middle latitudes to the equatorial region. The thickness of the F region is also found to increase after the SC during the first day of the storm. The "diurnal" part of the ionospheric storm effects is explainable by drift theory. The "storm-time" part can be explained as being produced by an enhanced loss coefficient at relevant height levels. The increase in the loss coefficient is believed to be caused by ionospheric heating during storms as inferred from satellite drag data. (auth)

**19022** ON THE ANGULAR DISTRIBUTION OF SHOWER PARTICLES GENERATED IN HIGH-ENERGY NUCLEAR INTERACTIONS. Gyoergy Bozóki, Ervin Fenyves, and Éva Gombosi. Magy. Tud. Akad. Kozp. Fiz. Kut. Int. Kozlemen., 6: 339-44(Sept.-Oct. 1958). (In Hungarian)

The angular distributions of shower particles produced in nuclear interactions having primary energy between $10^{10}-10^{14}$ ev are compared with theoretical distributions calculated on the basis of the theory of Fermi, Landau, and Heisenberg. It is shown that the angular distribution alone does not show unambiguously which of the above multiple meson production theories, if any, is the correct one. (auth)

**19023** THE INTERACTION MEAN FREE PATH OF PROTONS AT 3 Tev. G. Day, C. F. Gauld, C. B. A. McCusker, and L. W. Peak (Univ. of Sydney). Nuovo Cimento (10), 27: 977-8(Feb. 16, 1963). (In English)

The mean free path ($\Theta$) of singly charged primary particles in the energy region of 3 Tev is determined using a maximum-likelihood technique. With all events taken into account a value of $\Theta = 22$ cm is obtained. Considering only those events with a potential path greater than 20 cm, $\Theta$ becomes 27 cm. (auth)

**19024** COSMIC-RAY FLARE OF 1961 JULY 18 AND Y-SHAPED STAGE OF FLARES DEVELOPMENT AS PHASE-CONDITIONING EJECTION. L. Křivskii (Křivsky) (Astronomical Inst., Ondřejov, USSR). Nuovo Cimento (10), 27: 1017-18(Feb. 16, 1963). (In English)

A class 3+ flare occurred in the southern hemisphere of the sun on July 18, 1961. The temporal development of this flare is correlated with the solar cosmic-ray increases observed on earth. It is concluded that the solar cosmic-ray emission takes place during the formation of a second ascending emission filament in the flare, while this second filament is still connected with the stationary emission filament of the flare. (T.F.H.)

**19025** STUDY OF COMPOSITION OF PRIMARY COSMIC RADIATION AT AN ALTITUDE OF 320 KM. K. I. Alekseyev, L. L. Gabuniya, G. B. Zhdanov, E. A. Zamchalova, M. N. Shcherbakova, and M. I. Tret'Yakova. Planetary Space Sci., 11: 183-92(Feb. 1963). (Translated by H. S. H. Massey from Iskusst. Sputniki Zemli, No. 12, p.6, 1962.)

A small photographic emulsion stack was used to study the composition of primary cosmic radiation. The stack was exposed during the flight of the second Soviet satellite at an average altitude of 320 km for 24 hours between geographical latitudes −65° and +65°. The method used to identify fast, light cosmic nuclei was based on measurements of the impulse from multiple scattering and ionization from a count of δ-electrons and an analysis of interruptions. Relative flux of Li, Be, B, C, N, and O nuclei were given. (C.E.S.)

**19026** ENERGY SPECTRA OF DIFFERENT GROUPS OF COSMIC RAY NUCLEI FROM ČERENKOV COUNTER MEASUREMENTS IN SATELLITE VEHICLES. L. V. Kurnosova, V. I. Logachev, L. A. Razorenov, and M. I. Fradkin. Planetary Space Sci., 11: 193-208(Feb. 1963). (Translated by H. S. H. Massey from Iskusst. Sputniki Zemli, No. 12, p.16, 1962.)

Cherenkov counters in the second and third Soviet satellites were used to investigate the energy spectra of nuclei in the range $10^9-10^{10}$ ev/nucleon. Nuclei with charges of $Z \geq 5$, ≥12-14, ≥31-34, and >34 were recorded. The results were given on the basis of measurements of the latitude dependence of fluxes. Both the second and third satellites passed through the area between geographical

latitudes −65° and +65° and measured the latitude variation over a fairly wide range. (C.E.S.)

**19027** AN INSTANCE OF A TEMPORARY INCREASE IN THE INTENSITY OF HEAVY NUCLEI DURING THE FLIGHT OF THE THIRD SATELLITE. L. V. Kurnosova, L. A. Razorenov, and M. I. Fradkin. Planetary Space Sci., 11: 209-12(Feb. 1963). (Translated by O. M. Blunn from Iskusst. Sputniki Zemli, No. 12, p.31, 1962.)

A description of a short increase in the intensity of heavy nuclei was given. The intensity of nuclei with $Z \geq 12$-14 increased by a factor of 2.8 ± 1.4 compared with the mean value for geomagnetic latitudes 50-70°. The increase in intensity for nuclei with $Z \geq 5$ and $\geq 2$ was within the limits of statistical error throughout this period. This increased intensity was accompanied by a class $1^+$ solar chromosphere eruption and would suggest that the sun was a source of nuclei of different elements. (C.E.S.)

**19028** INVESTIGATION OF THE ENERGY SPECTRUM OF HIGH ENERGY μ-MESONS AT A DEPTH OF 40 METERS WATER EQUIVALENT. V. A. Dmitriev and G. B. Khristiansen (Moscow State Univ.). Zh. Eksperim. i Teor. Fiz., 44: 405-12(Feb. 1963). (In Russian)

The energy spectrum of μ mesons in the $10^{11}$ to $3.10^{12}$ ev range is derived from the spectrum of large bursts produced by high energy μ mesons under a lead filter at a depth of 40 m water equivalent. The results for energies $>10^{12}$ ev do not seem to be consistent with the creation of μ mesons as a result of $\pi^{\pm}$ or K decay. (auth)

**19029** μ-MESON GROUPS NEAR THE AXIS OF EXTENSIVE ATMOSPHERIC SHOWERS. Yu. N. Vavilov, G. I. Pugacheva, and V. M. Fedorov (Lebedev Inst. of Physics, Moscow). Zh. Eksperim. i Teor. Fiz., 44: 487-92(Feb. 1963). (In Russian)

The results of a search of narrow groups of μ mesons near the axis of extensive air showers with a number of particles $10^3 \leq N \leq 10^5$ are presented. Data are presented that indicate that there is no genetic relation between μ mesons moving at distances ≤0.3 m from each other. (auth)

**19030** SIZE DISTRIBUTION OF EXTENSIVE ATMOSPHERIC SHOWERS. Yu. A. Fomin and G. B. Khristiansen (Moscow State Univ.). Zh. Eksperim. i Teor. Fiz., 44: 666-75(Feb. 1963). (In Russian)

An abrupt change in the power exponent of the spectrum of extensive air showers with respect to number (N) of particles is observed for $N \sim 10^5$ to $10^6$ at sea level. It is shown that in order to explain this change it is sufficient to assume that the distribution of magnetic clouds in the galaxy with respect to the parameter lH (l is the size of the magnetic cloud and H is the magnetic field strength in it) is such that the diffusion coefficient D for ultrahigh energy cosmic rays changes from D = const to $D \sim E^{\alpha}$ (E is the energy) where $\alpha > 0.5$ when the energy changes by an order of magnitude or possibly even less. For a number of reasons this explanation seems to be probable. The composition of the primary radiation producing showers with $N \sim 10^7$ particles is discussed. An analysis of the experimental data shows that at any rate the primary radiation does not consist exclusively of heavy nuclei. (auth)

**19031** BAROMETRIC COEFFICIENT OF THE NEUTRON COMPONENT. A. V. Sergeev and A. A. Luzov. p.163-5 of "Kosmicheskie Luchi, No. 3." Moscow, Academy of Sciences, 1961.

Data concerning the seasonal change of the barometric coefficient β of the neutron component were obtained from observations at two (1 and 2) spaced points under similar conditions for recording neutron component variations. If the recording points are on close geomagnetic latitudes, the barometric coefficients $\beta_1$ and $\beta_2$ are equal ($\beta_1 = \beta_2 = \beta$), and the temperature effect can be neglected, then $\ln I_1 - \ln I_2 = \beta(h_2 - h_1)$, where I and h denote the intensity and the pressure at the points indicated. The recording of the neutron component variations was conducted with standard neutron monitors at two stations: Irkutsk (USSR, $\xi = 40.8°$; $\lambda = 174.4°$; altitude 433 m) and Deep River (Canada, $\xi = 57.5°$; $\lambda = 358°$; altitude 145 m). β was calculated using all available daily averages of intensities $\ln I_1$ and $\ln I_2$ and pressures $h_1$ and $h_2$ for the period from summer 1958 to spring 1959. (OTS)

## Criticality Studies

**19032** (APED-4220) PROPOSED TECHNICAL SPECIFICATIONS FOR THE EXPERIMENT FACILITY — MIXED SPECTRUM CRITICAL ASSEMBLY. (General Electric Co. Vallecitos Atomic Lab., Pleasanton, Calif.). Apr. 1, 1963. 31p.

Information concerning the critical facility site, building, ventilation, radiation monitoring, safeguards, and fuel storage is given along with information on the mixed spectrum critical assembly in the areas of mechanical design, core parameters, subcritical measurements, neutron detectors and nuclear instrumentation, safety, reactor control, and operations. (J.R.D.)

**19033** (NAA-SR-Memo-8195) CRITICALITY STUDY 15 w/o U−Zr ALLOY. N. Ketzlach (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Feb. 4, 1963. Contract [AT(11-1)-Gen-8]. 53p.

Maximum safe batch sizes were determined for all process steps involved in the melting and casting operations, as well as in the subsequent fuel handling procedures, of 15 wt % U−85 wt % Zr fuel rods. Criteria for hydrided as well as unhydrided rods are presented. A method is presented for the determination of an equivalent fuel rod diameter so that criticality data, developed for long rods can be used in establishing nuclear safety criteria for fuel rods of any length. Packaging criteria are presented for the safe storage and transport of the fuel materials in 30 × 30 × 30 in. birdcages as well as in 55-gal. drums. The criteria developed can be used to determine the maximum safe number of storage units in an array when each unit contains no more than 45% of the critical quantity of fuel in spherical geometry under optimum conditions of water moderation and reflection. This is independent of fuel composition. Thirty-three figures are given that have been used in the development of this criteria. (auth)

**19034** (ORNL-TM-499) CRITICAL MASS STUDIES. PART XIII. BOROSILICATE GLASS RASCHIG RINGS IN AQUEOUS URANYL NITRATE SOLUTIONS. J. T. Thomas, J. K. Fox, and E. B. Johnson (Oak Ridge National Lab., Tenn.). Feb. 6, 1963. Contract [W-7405-eng-26]. 11p.

The effect of commercially available borosilicate glass Raschig rings on the criticality of aqueous uranyl nitrate solutions enriched in $U^{235}$ was investigated. The natural-B content of the glass varied from 0.5 to 5.7 wt %, and the volume of the vessel occupied by the glass ranged from 20.9 to 30%. Results from exponential experiments, using a critical layer of solution above the column of solution-ring mixture as a neutron source, provided estimates of the material buckling of the mixture as a function of solution concentration, B content of the glass, and the glass volume present. It was shown, for example, that the buckling is negative (i.e., $k_{\infty} < 1$) if glass containing 4 wt % B

occupies more than 22% of the mixture volume, whereas the same concentration of glass containing only 0.5 wt % of B results in positive values of the buckling except for solutions more dilute than about 72 g of U per liter ($H : U^{235} \cong 380$). (auth)

**19035** (RFP-104) CRITICALITY CONTROL IN ENRICHED URANIUM RECOVERY OPERATIONS. Aurel Goodwin, Jr. and Arthur N. Nickel (Dow Chemical Co. Rocky Flats Plant, Denver). Apr. 18, 1958. Contract AT(29-1)-1106. 21p.

Accountability records of material transfers to the U recovery area allow a calculation of the probabilities of accidentally attaining a potential critical mass in the recovery operation. These probabilities are calculated and some suggestions are made for the lowering of these probabilities. (auth)

**19036** CRITICALITY OF AQUEOUS MIXTURES OF U-233 AND Th-232. M. Lowenfeld and A. Diaz (Allis-Chalmers Mfg. Co., Washington, D. C.). Atomics, 16: No. 2, 57(Mar.-Apr. 1963).

Two curves by which the critical radii and masses of infinitely long cylinders filled with aqueous mixtures of $U^{233}$ and $Th^{232}$ can be determined are presented. (M.C.G.)

**19037** "TITAN"—A NUCLEAR ASSEMBLY OF TOKYO INSTITUTE OF TECHNOLOGY. Y. Oyama, E. Takeda, M. Shindo, et al. Bull. Tokyo Inst. Technol., Spec. No. 49, 1-18(1962). (In English)

A detailed description is given of TITAN, an enriched uranium-light water subcritical assembly. The items involved in TITAN are listed, and its components are described: core, fuel element, water and gas system, and control system. Criticality measurements are reported. (D.L.C.)

## Elementary Particles and Radiations

*Refer also to abstracts 17639, 17648, 18527, 18531, 18532, and 18533.*

**19038** (GAMD-2874) A NUMERICAL METHOD FOR THE RADIATION TRANSPORT EQUATION IN PLANE GEOMETRY. B. E. Freeman (General Atomic Div. General Dynamics Corp., San Diego, Calif.). Jan. 22, 1962. Contract AF29(601)-2207. 20p.

A numerical method for performing time dependent calculations of radiative energy transport through slabs is developed. Contact with the diffusion approximation is retained by maintaining a parallel of numerical methods. The radiation intensity is removed from the equations, leaving only the material temperature. The integral equation for radiative transfer is derived, and limiting approximations and expressions are obtained. Stability of the difference equations obtained for radiation transport is also examined. (D.C.W.)

**19039** (GAMD-3074) SOME APPROXIMATIONS IN THE NUMERICAL TREATMENT OF RADIATION TRANSPORT THROUGH MEDIA WITH FREQUENCY-DEPENDENT ABSORPTION COEFFICIENTS. B. E. Freeman (General Atomic Div. General Dynamics Corp., San Diego, Calif.). Apr. 1, 1962. Contract AF29(601)-2207. 9p.

The previously discussed method of numerical treatment of radiation transport through slabs of material is extended to a medium having a frequency-dependent absorption coefficient. The extension involves factorization of the absorption coefficient to permit separation of the spectral and frequency-dependent parts of the calculation. (D.C.W.)

**19040** (KAPL-M-DNA-5) USE OF DIFFUSION THEORY CODES TO PREDICT GAMMA HEATING. Charles R. Greenhow, Gerhard O. Mueller, and Gerald E. Sabian (Knolls Atomic Power Lab., Schenectady, N. Y.). Jan. 1, 1963. Contract W-31-109-eng-52. 57p.

A method utilizing diffusion theory and existing nuclear codes has been developed that eliminates the necessity of transforming the true geometry and spatial gamma source distribution into an "equivalent" problem with one of the standard geometrical sources and a simple analytical spatial source distribution. This method also does away with the use of build up factors, which in a case with finite, complicated geometry; more than one medium; and slant penetration; can be only crudely estimated. A three step process is involved in obtaining gamma heating values by diffusion theory. Calculations using this method were made for several cases with simple geometry and source distributions and the results compare favorably with other, more widely accepted calculational methods. (auth)

**19041** (LNF-63/6) EFFECTS OF VIRTUAL VECTOR MESONS IN $e^+e^-$ COLLISIONS. Note No. 184. R. Gatto (Italy. Comitato Nazionale per l'Energia Nuclear. Laboratori Nazionali, Frascati). Feb. 12, 1963. 12p.

The vacuum polarization effects produced by virtual vector mesons in high-energy electron-positron interactions are estimated. Resonance contributions from the production and decay of these mesons in such reactions are also discussed. (T.F.H.)

**19042** (NP-12650) DECAY ASYMMETRIES OF CHARGED SIGMA HYPERONS. M. M. Nussbaum, R. W. Kraemer, A. Pevsner (Johns Hopkins Univ., Baltimore); M. Block, and A. Kovacs (Northwestern Univ., Evanston, Ill.). [1962]. 6p.

The quantity $\alpha P$ (product of the symmetry parameter and the average polarization) was studied for $\pi^+$-d and $\pi^-$-d reactions that result in $\Sigma^+$ and $\Sigma^-$ decay by several processes. Some 2500 events recorded in a bubble chamber filled with liquid deuterium and exposed to pion beams were measured. Results for $\alpha^+$ and $\alpha^0$ agree with other determinations while $\alpha^-$ was found consistent with zero. The average polarization for the reaction $\pi^+ + d \rightarrow \Sigma^+ + K^0 + p$ proved to be negative. (D.C.W.)

**19043** (TID-16260) EVIDENCE FOR SPIN ZERO OF THE $\eta$ FROM THE TWO GAMMA RAY DECAY MODE. M. Chrétien (Brandeis Univ., Waltham, Mass.); F. Bulos, H. R. Crouch, Jr., et al. (Brown Univ., Providence). July 13, 1962. Contract [AT(30-1)-2098]. 15p.

The reaction $\pi^- + p \rightarrow \eta^0 + n$ is studied at 1700 to 1740 Mev. The angular distributions of gamma pairs and of $3\gamma$, $4\gamma$, $5\gamma$, and $6\gamma$ prongs, which arise primarily from $\eta^0$ decay, are measured, and it is concluded that the spin of the $\eta^0$ is either 0 or 2. Information from Dalitz plots makes an assignment of 0 the more probable of the two. A discussion of the neutral decay modes of the $\eta^0$ is given. (T.F.H.)

**19044** (TID-16612) PRODUCTION OF MESONS AND BARYONS WITH ANOMALOUS HYPERCHARGES. Suraj N. Gupta (Argonne National Lab., Ill.). June 1962. Contract [W-31-109-Eng-38]. 4p. (UAC-6579)

Experiments are suggested for determining whether $\sigma^{\pm}$ mesons and $X^+$ and $Y^-$ baryons having hypercharges $= \pm 1$ exist, and if they exist, whether they decay via strong interactions. (T.F.H.)

**19045** (TID-16659) NEUTRON POLARIZATION IN THE 1 Mev REGION BY ELASTIC SCATTERING ON C, O, AND D. Leon E. Beghian, Kenzo Sugimoto, Manfred H. Wachter, and Jacques Weber (Massachusetts Inst. of Tech., Cambridge. Lab. for Nuclear Science). [Sept. 19, 1962]. Contract AT(30-1)-2098. 49p.

The polarization product $\underline{P}_1 \cdot \underline{P}_2$ for low-energy (~1 Mev) neutron elastic scattering was measured for C, $O_2$, and $D_2$ by the time-of-flight method. The $Li^7(p,n)$ reaction was used as a neutron source. Multiple scattering corrections were estimated by Monte Carlo calculation. The results are included and a method for measuring the Li target thickness by examination of time-of-flight profiles is described. (auth)

**19046** (TID-18295) COUPLED CHANNEL APPROACH TO $J = {}^3/_2{}^+$ RESONANCES IN THE UNITARY SYMMETRY MODEL. A. W. Martin and K. C. Wali (Argonne National Lab., Ill.). Dec. 1962. Contract [W-31-109-eng-38]. 45p. (UAC-7156)

The $p_{\frac{1}{2}}$ pseudoscalar meson-baryon scattering amplitudes in all isotopic spin and strangeness states are analyzed. In analogy with pion-nucleon scattering, the basic assumption that the single baryon exchange contribution provides the dominant force in these amplitudes is made, but all the coupled two-particle channels in each isotopic spin and strangeness state are included. A relativistic scattering matrix for each state is constructed by a matrix formulation of the N/D method so that it satisfies the requirements of unitarity and symmetry. Being fully relativistic, unlike the static model, the theory does not contain adjustable cutoff parameters. The known masses of the mesons and baryons and the Yukawa type meson-baryon coupling constants are the only parameters that enter into the calculation. The octet model of Gell-Mann and Ne'eman is used to define the coupling constants in terms of a single parameter f and the known pion-nucleon coupling constant. The requirement then that $N^*(T = {}^3/_2; S = 0)$, $Y_1^*(T = 1; S = -1)$, the recently observed $\Xi^*(T = {}^1/_2; S = -2)$ and a yet-to-be-discovered $Z^-(T = 0, S = -3)$ exist as a 10-fold representation of the unitary symmetry model restricts f to a rather narrow range. There are no other resonances in the $p_{\frac{1}{2}}$ state for f in this range, except possibly one in the T = 0, S = −1 system. The positions and widths of these resonances are discussed. 28 references. (auth)

**19047** (UCRL-6990-T) TRANSPORT OPERATOR THEORY OF MULTIPLE SCATTERING. J. R. Terrall (California. Univ., Livermore. Lawrence Radiation Lab.). July 1962. Contract [W-7405-eng-48]. 91p.

Multiple scattering phenomena are considered without imposing such traditional assumptions as an infinite medium, no energy changes in scattering, a scattering law restricted in energy or angle variations. Angle integrations, in fact, are carried through for any scattering law with no approximations. The particles considered are any having a distribution governed by the linear Boltzmann equation. It is shown quite generally that the particle current energy spectrum in any volume element can be related to the gradient of the angle-integrated flux spectrum. This relationship in general is not through a diffusion constant, but through a transport operator that takes into account not only all orders of spatial variation but also anisotropic scattering from all energies. This means that the flux and the current can be obtained from the solution of a single integro-differential equation rather than by synthesizing separate solutions of coupled equations. The angular components of the flux can be generated as desired, but it is not necessary that they be found explicitly in order to arrive at a solution to the problem. Further it is proved that it is always possible to synthesize the flux spectrum in a uniform region of space from functions that are separable in space and energy variations. Finally, it is shown that the transport operator can be written in terms of energy Green's functions that occur in the infinite medium-uniform source problem. These functions are extensions of the Placzek functions obtained for isotropic scattering. Besides linking the theory for finite media with the far simpler infinite medium-uniform source problem, the present treatment provides a framework for judging directly the adequacy of the many approximate theories. 23 references. (auth)

**19048** (UCRL-Trans-917(L)) THE PASSAGE OF ELECTRONS THROUGH THE ELECTRIC FIELD OF A LATTICE. H. Bethe. Translated by George Condas (Univ. of California Lawrence Radiation Lab., Livermore) from Z. Physik, 54: 703-10(1929). 10p.

A theory dealing with the deflection of electrons through a lattice electric field with a macroscopic lattice constant is presented. This theory explains the fact that the deflected rays have almost the same sharpness as the incident rays. It corresponds only partially with observed magnitude of the deflection. The diffraction of the de Broglie waves in a crystal is the superposition of a pure geometrically manipulated interference of waves, whose analogy is the Lave diffraction of x rays in crystals, and an electrodynamic deflection. (auth)

**19049** CORRECTIONS TO THE ELASTIC ELECTRON-DEUTERON SCATTERING CROSS SECTION. H. Neuer and P. Urban (Universität, Graz, Austria). Acta Phys. Austriaca, 16: 60-9(1963). (In German)

The elastic electron-deuteron scattering cross section was calculated by the Møller potential method. The deformation operator was used to the term $1/m^2$ (m is the nucleon mass) in the calculation and with that the scattering cross section also was calculated up to the term $1/m^2$. That means an improvement in comparison with previous works, in which the deformation operator was used only up to the term 1/m. (tr-auth)

**19050** EQUATIONS OF MOTION OF A ROTATING PARTICLE WITH MAGNETIC MOMENT. Andrzej Białas (Jagellonian Univ., Krakow). Acta Phys. Polon., 22: 499-510(Dec. 1962). (In English)

The equations of motion for a particle having non-zero rest mass, spin, charge, and magnetic moment are derived from Mathisson's variational principle. Methods similar to those applied by Weyssenhoff and Raabe are used for providing a physical interpretation of the equations derived. (auth)

**19051** UNIVERSAL FERMI INTERACTION AND ROTATIONAL SYMMETRY. W. Królikowski (Inst. for Nuclear Research, Polish Academy of Sciences, Warsaw and Univ. of Warsaw). Acta Phys. Polon., 22: Suppl., 51-7(1962). (In English)

A particular form of the overall neutral weak current is introduced in such a way that the whole universal Fermi interaction (UFI) displays a rotation and reflection symmetry in a formal three-dimensional space and at the same time the leptonic hyperon decays are considerably damped. This formal space is different from the usual isospace and may be called the weak isospace. Due to the proposed UFI there are two modes of $\mu$ decay, $\mu^- \to e^- + \bar{\nu} + \nu'$ and $\mu^- \to e^- + \bar{\nu}' + \nu$ with branching ratio 9 : 1 ($\nu$ and $\nu'$ denote two different neutrinos). This neutrino flip appears, however, only in processes among leptons alone. In other leptonic processes there is the pairing $(\bar{\nu}e^-)$ and

($\bar{\nu}\mu^-$) as a general rule. This UFI is compared with another UFI, having the same rotation and reflection properties in the weak isospace but forbidding the neutrino flip. (auth)

**19052** THE INTERACTION OF BARYONS WITH GRAVITATIONAL AND ELECTROMAGNETIC FIELD WITH RAYSKI'S SIX-DIMENSIONAL MANIFOLD. Jósef Namysłowski (Jagellonian Univ., Krakow). Acta Phys. Polon., 22: Suppl., 87-96(1962). (In English)

From the unitary theory of gravitation and electromagnetic field, given by Rayski, the generalized Dirac equations for the family of baryons interacting with gravitational and electromagnetic field are found. The connection of the proton charge with the singularity of metric is the same as was found by Rayski in the case of scalar complex field. (auth)

**19053** THREE PION WAVE FUNCTIONS METHOD OF "EFFECTIVE ANGULAR MOMENTUM." Ziro Koba (Inst. for Nuclear Research, Polish Academy of Sciences, Warsaw). Acta Phys. Polon., 22: Suppl., 103-25(1962). (In English)

A complete orthonormal set of wave functions for three free pions was worked out (up to $\Lambda \leq 4$), that satisfy the Bose statistics and possess definite values of the total angular momentum and the parity in the center of mass system as well as definite total isospin. An essential role in the construction procedure is played by a quantity, $\Lambda$, which is defined and is called tentatively "effective angular momentum". The states are most conveniently classified by $\Lambda$ and the total angular momentum. Similarity of $\Lambda$ to the magnitude of relative orbital angular momentum in the two-body problem is found to be far-reaching. This method can be extended to four or more pion systems. (auth)

**19054** EQUATIONS FOR THE VECTOR FIELD IN RAYSKI'S UNITARY THEORY. Elżbieta Białas and Andrzej Białas (Jagellonian Univ., Krakow). Acta Phys. Polon., 22: Suppl., 185-9(1962). (In English)

The equations for the vector boson field with a rest mass different from zero are derived from the variational principle in the frame of Rayski's unitary theory. The curvature of the six-dimensional manifold plays a role of the lagrangian. (auth)

**19055** RATE OF ENERGY LOSS OF RELATIVISTIC $\mu$-MESONS. J. E. Cousins (Univ. of Exeter, Eng.) and W. F. Nash. Advan. Phys., 11: 349-85(Oct. 1962). (In English)

The rate of energy loss by relativistic $\mu$ mesons by collision processes, bremsstrahlung, direct pair production, and nuclear interactions is reviewed. The theory and experimental work associated with these individual mechanisms is discussed and, where relevant, similar work on protons and electrons included. The combination of the individual effects are involved in range-energy measurements. Results of these experiments are presented, and the factors that limit their value considered. (auth)

**19056** TWO-NUCLEON INTERACTION AT LOW ENERGIES AND THE NUCLEON CORE. K. V. Laurikainen (Univ. of Helsinki), Seija Lyytikaeinen, and A. Perko. Ann. Acad. Sci. Fennicae, Ser. A VI, No. 111, 19p.(1962). (In English)

Following a survey of the two-nucleon interaction and the nucleon core, the effects of the core on the ground state of the deuteron are studied. It is shown that when the hard core is replaced by a soft core, one has to use different core potentials in the central part and in the tensor part of the interaction potential. The tensor core is shown to be usually attractive. (auth)

**19057** THEORETICAL STUDIES IN ANTINUCLEON ANNIHILATION STRUCTURES. H. Pilkuhn (Univ. of Stockholm). Arkiv Fysik, 23: 259-71(1963). (In English)

The newly discovered w and q pion resonances are included in the statistical treatment of antinucleon annihilation. General relations between angular asymmetries of charged annihilation mesons are derived. The magnitudes of these asymmetries are calculated by a modified statistical theory. (auth)

**19058** THE LONGITUDINALLY POLARIZED PROTON BEAM OF THE 6-METER SYNCHROCYCLOTRON. M. G. Meshcheryakov, Yu. P. Kumekin, S. B. Nurushev, and G. D. Stoletov. At. Energ. (USSR), 14: 38-40(Jan. 1963). (In Russian)

Quantitative investigation of the spin relationships of nuclear interactions at high energies requires the determination of the scattering of protons on protons and neutrons by accelerator studies; in such works in addition to nonpolarized and transversally polarized beams, the longitudinally polarized ones must also be taken into account. Such a program was carried out with the help of the 6-m synchrocyclotron of the Joint Institute for Nuclear Investigations at Dubna on the basis of a proposal of S. B. Nurushev et al. (JINI Preprint No. P-278, 1959). The polarization scattering work was carried out in the vertical plane above the synchrocyclotron chamber; a longitudinally polarized beam was obtained in the horizontal plane and the polarization vector was directed parallel or antiparallel to the proton pulse in the beam. The flux density was $2 \times 10^6$ protons/$cm^2$ sec. Analysis of the secondary p + p scattering on a polyethylene scatterer type polarimeter indicated an absence of vertical and transversal polarization components. (TTT)

**19059** THE PHYSICAL IDEAS IN THE NONLINEAR THEORY OF ELEMENTARY PARTICLES. Petur Raychev. Bulgar. Akad. Nauk. Fiz. Mat. Spisanie, 5: 176-82(1962).

The work of Heisenberg and associates, Schwinger, Feinman, et al., in the development of the nonlinear theory of elementary particles is reviewed. It was concluded that the results thus far obtained are sufficient for belief that this theory describes certain features of elementary particles at least qualitatively from a uniform standpoint, showing that there is a rational kernel in its fundamental ideas, although considerable mathematical difficulties mean that the theory is far from the stage when it can be compared with observable experimental results. (OTS)

**19060** ANALYSIS OF ENERGY LOSSES OF A 30-kev ELECTRON BEAM IN THE FLUORIDE, CHLORIDE, AND BROMIDE OF LITHIUM. Ferdinand Pradal and Claude Gout (Physique du Solide, Faculte des Sciences, Toulouse). Compt. Rend., 256: 1267-70(Feb. 4, 1963). (In French)

The energy loss of a 30-kev electron beam in films of LiF, LiCl, and LiBr were analyzed with a magnetic spectrograph. For LiF, the results are compared to the absorption curve in the ultraviolet. The rays observed seem due to the excitation of valence band electrons of the 2s band of $F^-$ and the 1s band of $Li^+$. In some cases, energy losses less than 10 ev were observed, which seems connected to the presence of color centers. (tr-auth)

**19061** NEW DETERMINATION OF THE BRANCHING RATIO (NEUTRAL MODES/ALL MODES) OF THE DECAY OF THE $\omega^0$ MESON. Charles d'Andlau, Andre Astier, Claude Ghesquière, et al. (Collège de France, Paris and CERN, Geneva). Compt. Rend., 256: 1279-81(Feb. 4, 1963). (In French)

A determination of the branching ratio of mesons ($\omega^0$) was determined from an analysis of 200,000 antiprotons.

A corrected value of 14.5 ± 3.5% was obtained. The histograms showed a weak accumulation around mass 550 Mev/$c^2$, the mass of the $\eta^0$ particle. The significance of this mass accumulation was discussed. (J.S.R.)

**19062** ENERGY SPECTRA OF ELECTRONS EMERGING FROM LEAD EXPOSED TO 320kVp WHITE X-RAYS. T. Inada, K. Kawashima, K. Hoshino, and H. Matsuzawa (National Inst. of Radiological Sciences, Chiba, Japan). Japan. J. Appl. Phys., 2: 99-105(Feb. 1963).

The energy spectra of secondary electrons, which emerge perpendicularly from a lead foil exposed to 320 kvp therapeutic white x rays (HVL = 3 mmCu), are observed by a double-focusing magnetic beta spectrometer. For the foil thicknesses 0.4–34 mg/cm$^2$ and the x ray incident angles less than 80°, the emerging electrons are found in the energy region less than 220 kev with the maximum counts at 50–80 kev (mean energy: 75–100 kev). For a given foil thickness, the spectral shape is almost independent of the incident angle of x rays. With the increase in foil thicknesses, however, the high-energy part of the spectra is markedly intensified. (auth)

**19063** REVERSED FIELD FOCUSING SYSTEMS FOR ELECTRON BEAMS WITH APPRECIABLE SPACE CHARGE DENSITIES. J. Kelly (Mullard Research Labs., Salfords, Lancs, Eng.). J. Electron. Control (1), 14: 21-63(Jan. 1963). (In English)

A method of focusing electron beams is described and a theory based on a laminar flow principle was developed. A series of design charts is presented and experimental work carried out in a demountable vacuum system is described. The theoretical and experimental studies are compared. A design procedure for a Reversed Field Focusing system is discussed and conclusions are drawn. (auth)

**19064** ELECTRONIC INTERACTION THEORY FOR TRANSVERSE-WAVE COUPLERS. T. Wessel-Berg (Stanford Univ., Calif.). J. Electron. Control (1), 14: 137-66 (Feb. 1963).

A general theoretical analysis is made of the interaction between transverse waves propagating on a filamentary electron beam and electromagnetic circuits. The class of circuits considered is that for which the transverse electric and magnetic fields are symmetric with respect to the z-axis. Aside from this restriction on the symmetry properties, the analysis is quite general in the sense that the transverse electric and magnetic field components are arbitrary functions of axial distance. Therefore, the analysis is valid for a variety of circuit configurations, ranging from simple coupler circuits, serving the purpose of coupling r-f power in and out of the beam in r-f and d-c-pumped devices, to transverse traveling-wave tubes and multicavity klystrons. The transverse field components in pump circuits used for parametric pumping and d-c pumping of transverse waves are all antisymmetric with respect to the z-axis and are therefore excluded from the present analysis. The analysis deals almost exclusively with the electronic part of the interaction, that is, how the transverse beam waves are affected by a specified electromagnetic circuit field. The merit of this approach is that it preserves generality, and leads to results which hold regardless of the details of the circuit configuration. Specifically, the analysis leads to the establishment of criteria for selective coupling to one or several transverse waves, expressed in terms of coupling integrals; it deals with power relations and discusses various methods of calculating the exchange of power between the beam waves and transverse circuit fields; it proves conclusively that the established form of the kinetic power conservation theorem is correct under the most general circumstances; and finally, the analysis deals with the question of whether or not the transverse waves are monoenergetic. It is shown that the waves generally are not monoenergetic, but carry a second-harmonic longitudinal modulation representing a spread in energy which under certain circumstances is comparable to the r-f energy carried by the waves. The energy spread depends on the details of the circuit field used for launching the waves, and is identically zero only for circularly polarized fields. (auth)

**19065** A δ-FUNCTION ANALYSIS OF TRANSVERSE WAVE INTERACTION IN PERIODIC STATIC FIELDS. Kjell Bloetekjaer and Bjarne Målsnes (Norwegian Defense Research Establishment, Kjeller, Norway). J. Electron. Control (1), 14: 187-214(Feb. 1963).

The interaction between transverse electron beam waves in periodic fields is usually analyzed by assuming a sinusoidal variation of the electric and magnetic fields. Another approach is used, assuming the fields to consist of δ functions. Exact solutions can then be obtained by standard mathematical methods. The interaction in quadrupole fields, two-dimensional fields, and fields of rotational symmetry is considered, and the results are shown to agree well with the sinusoidal-field theory. Extensive numerical calculations are presented. (auth)

**19066** ANALYSIS OF NUCLEAR INTERACTIONS OF ENERGIES BETWEEN 10 AND 1000 Gev. Ervin Fenyves, Éva Gombosi, and Péter Surányi. Magy. Tud. Akad. Kozp. Fiz. Kut. Int. Kozlemen., 6: 345-50(Sept.-Oct. 1958). (In Hungarian)

The angular and energy distributions of shower particles from seven interactions, mostly complex collisions, were measured. The Lorentz factor $\gamma_{cm}$ in the center-of-mass system (CMS) was determined from the energy of secondaries, and the Lorentz factor $\gamma_{sym}$ in the symmetry system was obtained from the angular distribution. It was found that $(\gamma_{sym}/\gamma_{cm}) = 0.92 \pm 0.15$, which corresponds to a symmetrical emission of shower particles in the CMS. Energy distribution in the CMS as well as transversal momentum distribution were also determined. (auth)

**19067** THE POLARIZATION OF ELASTICALLY SCATTERED GAMMA RAYS. István Lovas. Magy. Tud. Akad. Kozp. Fiz. Kut. Int. Kozlemen., 6: 367-72(Sept.-Oct. 1958). (In Hungarian)

The polarization of elastically scattered gamma rays by Delbrück scattering is different from the polarization of gamma rays scattered by other processes. This difference gives an experimental possibility to prove the existence of Delbrück scattering. (auth)

**19068** BOUND STATES IN MESON PAIR THEORY (THE NK HYPERON-MODEL). Géza Gyoergyi. Magy. Tud. Akad. Kozp. Fiz. Kut. Int. Kozlemen., 6: 373-9(Sept.-Oct. 1958). (In Hungarian)

Bound states assuming a vector interaction in meson pair theory are studied. The problem thus treated may be considered as the field theoretical model of the NK hyperon-model. (auth)

**19069** SELECTION RULE FOR WEAK INTERACTIONS. Nőra Menyhárd. Magy. Tud. Akad. Kozp. Fiz. Kut. Int. Kozlemen., 6: 380-3(Sept.-Oct. 1958). (In Hungarian)

Expressions, that are consistent with known conservation laws, for many processes among the weak interactions that ought to occur in nature can be found. Such processes are: $\mu^- + p \rightarrow p + e^-$, $\mu^+ \rightarrow e^+ + e^+ + e^-$, $K^+ \rightarrow \pi^+ + \mu^+ + e^-$, $K^+ \rightarrow \pi^+ + e^+ + e^-$, $K^+ \rightarrow \pi^+ + \mu^+ + \mu^-$, $K^0 \rightarrow \pi^0 + e^+ + e^-$, $\Sigma^+ \rightarrow p + \nu + \bar{\nu}$, and $U^+ \rightarrow \pi^+ + \nu + \bar{\nu}$. (auth)

**19070** ON THE SECOND ORDER WAVE EQUATION OF FERMIONS. Gyoergy Marx. Magy. Tud. Akad. Kozp. Fiz. Kut. Int. Kozlemen., 6: 384-96(Sept.-Oct. 1958). (In Hungarian)

Following Feynman's suggestion some problems in the description of spinor fields by a second order wave equation are studied in detail. The possibility of representing the iso-doublet fermions by a four component spinor is shown. This facilitates the formulation of the commutation law and may serve as a model of the invariance properties of the Heisenberg equation. (auth)

**19071** MEAN LIFE AND MASS OF ELEMENTARY PARTICLES. Samuel C. Horning. Nature, 197: 1091-2 (Mar. 16, 1963).

The weak interaction constant, the fine structure constant, and the Compton wave length of the electron are used to determine the mean life and mass of some elementary particles. (C.E.S.)

**19072** PHOTOPRODUCTION OF INTERMEDIATE VECTOR BOSONS. M. Bander (Universitet, Copenhagen). Nucl. Phys., 41: 47-52(Feb. 1963). (In English)

A peripheral collision calculation of the process $\gamma + p \rightarrow W + \ldots$, where W is an intermediate vector boson, is performed. Results and possible detection schemes are discussed. (auth)

**19073** ELECTROMAGNETIC CASCADES AND POLARISATION OF THE MEDIUM. S. K. Srinivasan (Indian Inst. of Tech., Madras). Nucl. Phys., 41: 202-9(Mar. 1963). (In English)

The theory of electromagnetic cascades is reviewed on the basis of the cross section for bremsstrahlung of an electron in polarizing media. The finiteness of this total cross section enables explicit expressions to be obtained for the mean behavior with inclusion of ionization loss. The method of solution is demonstrated by dealing with the number of electrons produced in a certain thickness of matter, the energy of each electron being greater than E at the time of its production. (auth)

**19074** POLARIZATION BY SPIN-ORBIT FORCES IN NUCLEON-NUCLEON SCATTERING. T. Gajewski (Univ. of Lodz, Poland). Nucl. Phys., 41: 323-9(Mar. 1963). (In English)

Scattering amplitude and polarization in nucleon-nucleon scattering with spin-orbit interaction are calculated. In the $L \cdot S$ force model the expressions for the scattering amplitude and polarization in terms of the triplet phase shifts are obtained. The scattering amplitude is shown to be a special case of the general form. (auth)

**19075** PROTON-PROTON POLARIZATION BETWEEN 27 Mev AND 100 Mev. P. Christmas and A. E. Taylor (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Nucl. Phys., 41: 388-400(Mar. 1963). (In English)

The polarization in p-p scattering was measured at various energies between 27 Mev and 100 Mev in a counter experiment using the 150 Mev, 48% polarized proton beam of the Harwell synchrocyclotron incident on a liquid hydrogen target. The beam energy was reduced by suitable absorbers, and the mean energy and energy resolution of each measurement were defined by absorbers in an anticoincidence range counter telescope. A solenoid was used to rotate the polarization of the beam through ±180° in order to eliminate geometrical false asymmetries. It was found possible to represent the energy dependence of the polarization by a simple power law $P = aE^b$ up to about 70 Mev. (auth)

**19076** ANGULAR DISTRIBUTIONS FOR n-p SCATTERING IN THE ENERGY RANGE 22.5 TO 110 Mev. J. P. Scanlon (Atomic Energy Research Establishment, Harwell, Berks, Eng.), G. H. Stafford, J. J. Thresher, P. H. Bowen, and A. Langsford. Nucl. Phys., 41: 401-23(Mar. 1963). (AERE-R-4166) (In English)

Measurements of the differential cross sections for n-p scattering were made in the energy range 22.5 to 110 Mev at center-of-mass angles between 7 and 173°, using a neutron time-of-flight spectrometer in conjunction with the Harwell cyclotron. At angles between 7 and 122° absolute cross sections were obtained using a calibrated neutron detector and between 78 and 173° relative cross sections, subsequently normalized to the absolute measurements, were obtained by detecting the recoil protons. Within the limits of the experimental errors, the results are in agreement with previous measurements at 27, 42, 90, and 105 Mev and provide new information at other energies. (auth)

**19077** ON THE DISPERSION THEORY OF PION-NUCLEON DIFFRACTION SCATTERING. A. Krzywicki and J. Wrzecionko (Inst. for Nuclear Research, Polish Academy of Sciences, Warsaw). Nucl. Phys., 41: 439-47(Mar. 1963). (In English)

The validity of Amati et al's theory of diffraction scattering in the Bev region is examined. It is shown that if the t-dependence of the imaginary parts of the scattering amplitudes in the unphysical region ($t > 0$) and the contribution of many-body intermediate states in the t-channel are neglected, either too small a height or too large a width of the calculated diffraction peak is obtained as compared with experimental data. (auth)

**19078** STUDY OF NUCLEAR MAGNETIC TRANSITIONS BY INELASTIC ELECTRON SCATTERING. W. C. Barber, J. Goldemberg, G. A. Peterson, and Y. Torizuka (Stanford Univ., Calif.). Nucl. Phys., 41: 461-81(Mar. 1963). (In English)

The energy spectrum of inelastically scattered electrons at 180° was measured for 41.5 Mev electrons from the Stanford Mark II Linear Accelerator for the following elements: $D^2$, $Li^6$, $Li^7$, $N^{14}$, $O^{16}$, $F^{19}$, $Ne^{20}$, $Na^{23}$, Mg, $Al^{27}$, $P^{31}$, $S^{32}$, $Ar^{40}$, $K^{39}$, $Ca^{40}$, and $Bi^{209}$. Some of the elements investigated show clear evidence of excitation of nuclear levels. It is shown that these excitations are most likely due to magnetic dipole transitions. The experiment was performed under conditions in which the long wave approximation is approximately valid, so radiation widths were derived for the excited states. A comparison is made with the single particle model predictions. A systematic behavior of some M1 transitions in light nuclei suggested recently by Kurath is supported by the data. The radiation tail was investigated in some detail and the large-angle bremsstrahlung formula of McCormick, Keiffer, and Parzen was found to agree with the data for gas targets. (auth)

**19079** FINAL STATE INTERACTION CORRECTIONS TO INELASTIC NUCLEON-NUCLEON SCATTERING. M. Bander (Universitet, Copenhagen). Nucl. Phys., 41: 529-33(Mar. 1963). (In English)

The final-state interaction corrections to the peripheral model calculation of the process $n + n \rightarrow n + n + \pi$ (n ≡ nucleon) are calculated. Methods of calculation and comparison with experiment are discussed. (auth)

**19080** CONNECTION BETWEEN NEUTRON AND PROTON EMISSION BY ABSORPTION OF $\pi^-$-MESONS. P. Huguenin (Universität, Bonn). Nucl. Phys., 41: 534-8(Mar. 1963). (In German)

Under the assumption that the rate of absorption of $\pi^-$ in nuclei can be estimated by a second order perturbation cal-

culation starting from the pion-nuclear interaction on the one hand, and from the phenomenological nuclear forces on the other hand, the ratio (R) of the numbers of fast neutrons and fast protons emitted after a $\pi^-$ is absorbed can be calculated. The use of a Serber force leads to reasonable agreement with experiment. The variation of R with Z can be understood from the fact that the $\pi^-$ is absorbed from a s-state when the nucleus is light, and from a p-state when the nucleus is heavier. (auth)

**19081** MATRIX ELEMENTS IN THE THEORY OF THE QUANTIZED FIELD OF PROBABILITY AMPLITUDE. I. Yu. Krivskii (Krivsky) (Uzhgorod State Univ., Ukrainian SSR). Nucl. Phys., 41: 539-46(Mar. 1963). (In English)

A connection independent of the perturbation method is established in self-contained form between the matrix elements of the quantized field of probability amplitude for an arbitrary value of a new constant I and the corresponding matrix elements of the conventional theory of quantized fields. It is shown that the calculation by the new theory, for an arbitrary value of I, of the parameters of processes usually observed experimentally reduces to the calculation of the corresponding parameters of these processes by the conventional theory of quantized fields. (auth)

**19082** THE SINGLE QUANTUM ANNIHILATION OF POSITRONS. H. Langhoff, H. Weigmann, and A. Flammersfeld (Universität, Gottingen, Ger.). Nucl. Phys., 41: 575-83(Mar. 1963). (In German)

Single-quantum annihilation of positrons in the field of high-Z nuclei is studied with the aid of a $\beta$ spectrometer and a counter telescope. Performing a thin-target experiment, monoenergetic $\gamma$ quanta from single-quantum annihilation are observed. The total cross section of this decay mode, measured in the energy range from 260 to 1400 kev, is found to be in agreement with calculations. According to these measurements, a positron of 1500 kev kinetic energy, stopped in a lead absorber, has a probability of 0.17% to annihilate by the emission of a single $\gamma$ quantum. (auth)

**19083** A METHOD TO DESCRIBE CORRELATIONS OF PROTONS AND NEUTRONS. B. Brémond and J. G. Valatin (Univ. of Birmingham, Eng.). Nucl. Phys., 41: 640-59 (Mar. 1963). (In English)

An approximation method is presented that takes into account additional four-particle correlations and that can be applied to describe the pairing correlations between protons and neutrons in nuclei. The trial ground-state vector introduces a competition between the formation of pairs of particles and of four-particle clusters and includes as a special case the superconducting state vector. The mathematical form of the state vector permits a simple calculation of expectation values, and the unknown parameters are determined by a linear eigenvalue equation system derived from a variational principle. The eigenvalues give the approximate excitation energies of low-lying double excitations, and a linearized Hamiltonian is constructed that has these eigenvalues and describes the whole spectrum of quasi-particle energies. Its diagonalization introduces a quasi-particle transformation, the features of which are analyzed. The secular equation of the double excitations leads to a fourth-order algebraic equation. This equation reduces to a cubic equation in the symmetric case of an equal number of protons and neutrons. Qualitative features of the solution can be followed without an explicit solution of this equation, and explicit expressions are given for the excitation spectrum at the Fermi level. (auth)

**19084** PRODUCTION OF PARTICLES IN THE INTERACTIONS $\pi^-$-p AT 5 Gev. I. CALCULATION OF MULTIPLICITIES BY STATISTICAL THEORY. R. Laverrière and J. Gréa (Institut de Physique Nucléaire, Faculté des Sciences, Lyon). Nucl. Phys., 41: 660-4(Mar. 1963). (In French)

Calculation of multiple particle production in $\pi^-$-p interactions at 5 Bev is made by means of the statistical theory and a method of approximation for calculating phase-space integrals, $\pi$-$\pi$, Y-$\pi$, and N-$\pi$ resonances are taken into account. (auth)

**19085** PRODUCTION OF PARTICLES IN THE INTERACTIONS $\pi^-$-p AT 5 Gev. II. DISCUSSION OF RESULTS. R. Laverrière and G. Philbert (Institut de Physique Nucléaire, Faculté des Sciences, Lyon). Nucl. Phys., 41: 665-8(Mar. 1963). (In French)

Results on multiple particle production in $\pi^-$-p interactions at 5 Bev are discussed. The importance of the introduction of new resonances, the determination and the influence of parameters, and the validity of the statistical theory are examined. (auth)

**19086** $\pi^-$-MESON INELASTIC INTERACTIONS AT 16.2 Gev/c IN EMULSIONS. S. Ciurlo (Università, Genoa), E. Picasso, G. Tomasini, A. Gainotti, C. Lamborizio, and S. Mora. Nuovo Cimento (10), 27: 791-803(Feb. 16, 1963). (In English)

698 interactions, produced in nuclear emulsions by 16.2-Bev/c $\pi^-$ mesons, are found. $\pi^-$-nucleus and $\pi^-$-nucleon interactions are analyzed. For these latter energy measurements are made on the secondaries, in order to obtain some information about angular and momentum distributions in the $\pi^-$-nucleon c.m.s. A discussion is given of these distributions. (auth)

**19087** ELIMINATION OF THE BACKGROUND INTEGRAL IN THE REGGE FORMULA. A. M. Kaufman (Brandeis Univ., Waltham, Mass.). Nuovo Cimento (10), 27: 804-15(Feb. 16, 1963). (In English)

It is shown that under conditions of boundedness of the S-matrix in the left half-plane, the background integral in the Regge formula can be removed. Removal of the background integral forces the introduction of an infinite number of fixed poles in addition to the Regge poles. This result points out the basic nonremovability of the contribution of the background integral. (auth)

**19088** "GLANCING" COLLISIONS OF PIONS WITH PROTONS AT 6.1 AND 18.1 Gev/c. G. Bellini (Università, Milan and Istituto Nazionale di Fisica Nucleare, Milan), E. Fiorini, A. J. Herz, et al. Nuovo Cimento (10), 27: 816-33(Feb. 16, 1963). (In English)

An analysis is presented of inelastic hydrogen-like interactions with two or four charged prongs. An event is accepted only if one of the prongs is caused by a slow recoil proton and if no strange particles are associated with it. The interactions are observed in a propane/freon bubble chamber. Because of the adopted selection criteria, there is ≈75% detection probability for neutral pions through conversion of at least one of its decay photons. The analysis is carried out using the one-particle-exchange model as a guide, and the features of the events are found to be consistent with it. In a proportion of the events there is a secondary negative pion of almost the full primary momentum; this can be explained by diffraction off the exchanged virtual pion. In about 72% of the inelastic interactions with two charged prongs only one neutral pion is emitted. (auth)

**19089** S-MATRIX AND T-MATRIX ZEROS IN TWO STATIC MODELS. W. D. McGlinn and C. H. Albright (Northwestern Univ., Evanston, Ill.). Nuovo Cimento (10), 27: 834-49(Feb. 16, 1963). (In English)

The dynamical assumption of a minimum of S-matrix

zeros is applied to neutral pseudoscalar and symmetric scalar meson theories in the static limit and one-meson approximation. In both models the generality in the S-matrix solutions is reduced to a one-parameter class with an upper bound on the coupling constant. A low-energy narrow resonance is admissible in the $P_{\frac{1}{2}}$ channel for the pseudoscalar model, while only a large s-wave scattering length can appear in the $T = \frac{3}{2}$ channel for the scalar case. Crossing symmetry and unitarity are used to demonstrate that the class of solutions possessing no zeros in the scattering amplitudes is entirely contained in the class of solutions with a minimum number of S-matrix zeros. All members of the two classes necessarily exhibit $\pm\pi/2$ asymptotic phase shifts. (auth)

**19090** ANNIHILATION IN FLIGHT OF 200 AND 800 Mev POSITRONS. A. Browman and J. Pine (Stanford Univ., Calif.). Nuovo Cimento (10), 27: 850-5(Feb. 16, 1963). (In English)

The total cross sections for annihilation in flight of 200- and 800-Mev positrons are measured. The ratio of the two cross sections is determined to an accuracy of 2.5% and is in accord with theory, while the absolute values are about (5 ± 2.5)% low. From the measured ratio, there is no evidence for a deviation from theory that depends on the momentum transfer. The possible discrepancy in absolute value may arise from systematic corrections to the experiment. (auth)

**19091** A STATISTICAL INTERPRETATION OF LARGE-ANGLE ELASTIC SCATTERING. G. Fast, R. Hagedorn, and L. W. Jones (CERN, Geneva). Nuovo Cimento (10), 27: 856-9(Feb. 16, 1963). (In English)

The statistical model of particle production makes definite predictions about "compound-elastic" scattering cross sections. Such predictions are available in a numerical form for $\pi$-N (N = nucleon) and p-p collisions with primary energy (laboratory system) between zero and about 20 to 30 Bev. The result is that the "compound-elastic" cross section for $\pi$-N should show the following dependence on the total center-of-momentum energy E (measured in Bev): $4\pi(d\sigma_{el}/d\Omega)|_{large\ angles} \equiv \langle\sigma_E\rangle \approx \sigma_{inel} \cdot \exp[-3.17(E - 1.40)]$ f(E), where f(E) is a slowly varying function representing the "inelasticity." Experimental results are compared to this prediction and qualitative agreement is found. (auth)

**19092** CLASSIFICATION OF MESONS IN A COMPOUND MODEL. D. B. Lichtenberg (Stanford Univ., Calif.). Nuovo Cimento (10), 27: 860-7(Feb. 16, 1963). (TID-16702) (In English)

Mesons are considered as bound states of antibaryon-baryon pairs. The bound states of lowest quantum numbers correspond to the observed mesons, to the extent that the quantum numbers of the latter are known. In the model it is possible to have mesons of zero strangeness that are not eigenstates of G parity. (auth)

**19093** ON THE INTRODUCTION OF PARTICLE POSITIONS IN RELATIVISTIC QUANTUM MECHANICS. P. Beckmann (Institut für Kernphysik, Mainz). Nuovo Cimento (10), 27: 868-73(Feb. 16, 1963). (In English)

Variables that can be interpreted as the positions of particles are introduced in relativistic quantum mechanics in a Lorentz-invariant way. This introduction is made possible by the use of suitably defined coordinate systems, in which each homogeneous Lorentz transformation corresponds to a three-dimensional rotation. Therefore, the method is similar to the one adopted in the conventional treatment of angular momentum in relativistic quantum mechanics. (auth)

**19094** ON THE SYMMETRY RELATIONS OF THE 3-j SYMBOLS. T. Shimpuku (Shiga Prefectural Junior Coll., Hikone Shiga, Japan). Nuovo Cimento (10), 27: 874-85 (Feb. 16, 1963). (In English)

There are 72 symmetry relations in the 3-j symbols. These symmetry relations are discussed algebraically and their geometrical meaning is investigated. As an application, some formulas for 3-j symbols are obtained, and it is verified that in the numerical estimation of a Clebsch-Gordan coefficient or a 3-j symbol, the symmetry relations considerably diminish the exertion of enumeration. (auth)

**19095** A SEARCH FOR THE DECAY $\mu \rightarrow e + \nu[\gamma]$. S. Frankel (Univ. of Pennsylvania, Philadelphia), W. Frati, J. Halpern, L. Holloway, W. Wales, and O. Chamberlain. Nuovo Cimento (10), 27: 894-912(Feb. 16, 1963). (In English)

A search for the decay $\mu \rightarrow e + \gamma$ is made using spark chambers and sodium iodide crystals. The spark chambers provide the means of measuring the angle between the electron and photon, while the sodium iodide crystals are used to measure the particle energies. A lithium target and thin (0.001 in.) aluminum foils in the spark chamber are used to minimize the scattering of the electron. An upper limit of $4.3 \cdot 10^{-6}$ (90% confidence) is found for the ratio of the rate of the $\mu \rightarrow e + \gamma$ decay to the normal muon decay rate. A search for the decay $\mu \rightarrow e + \gamma + \gamma$ is also made. (auth)

**19096** THE ASYMPTOTIC PROPERTIES OF THE MULTIPERIPHERAL MODEL IN THE WEAK COUPLING APPROXIMATION. L. Bertocchi (Università, Bologna and Istituto Nazionale di Fisica Nucleare, Bologna), E. Predazzi, A. Stanghellini, and M. Tonin. Nuovo Cimento (10), 27: 913-21(Feb. 16, 1963). (In English)

The asymptotic properties of the multiperipheral model are investigated in the weak coupling limit. The mechanism under which the ladder graphs considered by the model sum up to give Regge pole behavior is exhibited, and an expression for the Regge trajectory is obtained. (auth)

**19097** ONE-PHOTON EXCHANGE PROCESSES AND RADIATIVE CORRECTIONS. V. Georgé, M. Locher, and H. Rollnik (CERN, Geneva). Nuovo Cimento (10), 27: 928-46(Feb. 16, 1963). (In English)

The Weizsäcker-Williams method is discussed. It is shown how gauge invariance guarantees the vanishing of the longitudinal cross section for zero momentum transfer. Explicit calculations are carried out for virtual Compton scattering, and are applied to determine the radiative corrections from hard photons in muon-electron scattering. (auth)

**19098** A VARIATIONAL PRINCIPLE FOR SCATTERING PHASE SHIFTS. F. Calogero (Princeton Univ., N. J.). Nuovo Cimento (10), 27: 947-51(Feb. 16, 1963). (In English)

Variational formulas for the tangent of the phase shift and for the phase shift itself are derived. (auth)

**19099** SECOND-TYPE SINGULARITIES IN PERTURBATION THEORY. M. Fowler (Cambridge Univ., Eng.). Nuovo Cimento (10), 27: 952-9(Feb. 16, 1963). (In English)

The second type (non Landau) of singularities of perturbation theory are investigated. It is shown that they can be represented by a graphical analysis similar to dual diagrams. The discontinuity across cuts associated with second-type singularities is deduced. (auth)

**19100** ABSORPTION OF $\gamma$-RAYS IN CRYSTALS AND THE PRODUCTION AND ANALYSIS OF LINEARLY POLARIZED $\gamma$-RAYS. N. Cabibbo (CNEN, Rome and Università, Rome), G. Da Prato, G. De Franceschi, and U. Mosco.

Nuovo Cimento (10), 27: 979-94(Feb. 16, 1963). (In English)

Coherence effects on the total pair production cross section in crystals at high energy are studied. These effects are dependent on the photon polarization, and can be used for the production and analysis of linearly polarized $\gamma$ beams. (auth)

**19101** SOLUBLE MODELS IN MANY-BODY SCATTERING AND COMPLEX ANGULAR MOMENTA. E. Kazes (Pennsylvania State Univ., University Park). Nuovo Cimento (10), 27: 995-1006(Feb. 16, 1963). (In English)

The interaction of a particle with a rigid rotator by means of a superposition of separable potentials is examined, and some exactly soluble cases are displayed. At any energy the continuation of the elastic amplitudes to complex angular momenta is shown to yield a meromorphic function in any finite region of the complex angular momentum plane. The inelastic amplitudes have simple kinematic cuts that are readily removable, leaving again a meromorphic function of angular momenta. (auth)

**19102** THE SCATTERING OF A DIRAC PARTICLE ON A CENTRAL SCALAR POTENTIAL. F. Calogero (Princeton Univ., N. J.). Nuovo Cimento (10), 27: 1007-16(Feb. 16, 1963). (In English)

The approach to potential scattering is extended to Dirac particles. Variational formulas for the tangent of the phase shift and the phase shift itself are obtained. Approximate formulas are also given. (auth)

**19103** DISPERSION THEORY OF THE DEUTERON FORM FACTOR AND ELASTIC e-d SCATTERING. H. F. Jones (Imperial Coll., London). Nuovo Cimento (10), 27: 1039(Feb. 16, 1963). (In English)

Corrections to deuteron form factors and e-d scattering cross sections are discussed. (T.F.H.)

**19104** MEASUREMENT OF g/m FOR MUONS. G. McD. Bingham (Univ. of California, Berkeley). Nuovo Cimento (10), 27: 1352-8(Mar. 16, 1963). (UCRL-10346) (In English)

A free-running "muon stroboscope" was used to measure the ratio of the precession frequencies of muons (f) and protons ($f_p$) in water for the same magnetic field. The stroboscope frequency was 200 Mc. The results obtained were: positive muons stopping in bromoform $(f/f_p)^+ = 3.18336 \pm 0.00007$, and negative muons stopping in water $(f/f_p)^-_{H_2O} = 3.1808 \pm 0.0004$. The first ratio was assumed to be also that of the free particles, and led to the following values for $(g/m)^+$ and $m^+$: $(g/m)^+ = (9.6840 \pm 0.0002) \times 10^{-3}\ m_e^{-1}$, $m^+ = (206.766 \pm 0.005)\ m_e$ where $m_e$ = the electron mass. A diamagnetic correction was applied to the second ratio and an equivalent value $(g/m)^-_{H_2O}$ was obtained for negative muons stopping in water: $(g/m)^-_{H_2O} = (9.6760 \pm 0.0013) \times 10^{-3}\ m_e^{-1}$. Assuming equal masses for positive and negative muons, $(g^-(H_2O) - g^+)/g^+ = -(8.3 \pm 1.4) \times 10^{-4}$. Analyzing and correcting the experimental results, $m^+ = (206.765 \pm 0.002)\ m_e$ and $(g^-(H_2O) - g^+)/g^+ = -(8.9 \pm 0.8) \times 10^{-4}$. (auth)

**19105** THE ELECTROPRODUCTION OF A PION FROM A NUCLEON. I. M. Barbour (Univ. of Glasgow). Nuovo Cimento (10), 27: 1382-1404(Mar. 16, 1963). (In English)

The N/D method of solution is applied to the electroproduction of a pion from a nucleon. The scattering amplitude is derived using the Mandelstam representation in the low-energy region around the $(^3/_2, ^3/_2)$ resonance. Preliminary results are discussed. (auth)

**19106** MEAN LIFE-TIME OF THE NEUTRAL PION. E. L. Koller, S. Taylor, and T. Huetter (Stevens Inst. of Tech., Hoboken, N. J.). Nuovo Cimento (10), 27: 1405-9 (Mar. 16, 1963). (In English)

The mean lifetime of the $\pi^0$ meson is measured. The decay distance of $\pi^0$ mesons produced by $K_{\pi 2}$ decay at rest ($K^+ \rightarrow \pi^+ + \pi^0$) and subsequent decay by the Dalitz mode ($\pi^0 \rightarrow e^+ + e^- + \gamma$) is measured. Using Ilford G-5 emulsions, exposed in a 300 Mev/c separated $K^+$ beam, 88 of the above events are found. The observed mean $\pi^0$ lifetime is $(2.8 \pm 0.9) \times 10^{-16}$ sec. (auth)

**19107** PHOTOPRODUCTION OF STRANGE PARTICLES. M. Gourdin (CERN, Geneva) and J. Dufour. Nuovo Cimento (10), 27: 1410-30(Mar. 16, 1963). (In English)

Associated photoproduction is studied in a model in which the effects of pion-nucleon interactions are simulated by isobars. A general treatment of photoproduction, as well as the multiple expansion of the transition amplitude, is given for the two possible cases of relative parity of the system K-hyperon-nucleon. The isobaric terms are calculated from data deduced from other phenomena. The effects of pion-kaon and pion-hyperon resonances are studied. (tr-auth)

**19108** CALCULATION OF THE YUKAWA COUPLING CONSTANT. R. Delbourgo (Imperial Coll. of Science and Tech., London). Nuovo Cimento (10), 27: 1431-8(Mar. 16, 1963). (In English)

By expressing Feynman diagrams as dispersion integrals with a finite cut-off, a lowest-order calculation is performed of the renormalization constants $Z_1$, $Z_2$, and $Z_3$, for a Yukawa coupling. By setting each Z equal to zero, the approximate solutions $g^2/4\pi = 0$ (30) and $\mu/m \leq 0.2$ are obtained, with a cut-off of about 3 nucleon masses. (auth)

**19109** THREE-NEUTRINO HYPOTHESIS. K. Hiida (Argonne National Lab., Ill.). Nuovo Cimento (10), 27: 1439-49(Mar. 16, 1963). (TID-17613; UAC-6966). (In English)

The ordinary law of conservation of lepton number is assumed. For leptonic weak interactions the usual assumptions are: the existence of two neutrinos; no neutrino flip; and no neutral current. Since these cannot all be true if the conservation law is to hold, a third neutrino is introduced as the simplest modification of the first assumption. This neutrino is the one from K-$\mu$ decay. Under the three-neutrino hypothesis, the discrepancy between the ratio $G_v/G_\mu$ and unity (where $G_v$ is the vector coupling constant for $\beta$-decay and $G_\mu$ is the $\mu$-decay coupling constant) is explained in a manner consistent with the small branching ratio in the leptonic decay of hyperons. It is shown that the hypothesis is relatively easy to prove or disprove by experiments on high-energy neutrino reactions, if about 50% or more of the neutrinos are obtained from K-$\mu$ decay. (auth)

**19110** AN APPROACH TO THE THEORY OF SINGLE PION PRODUCTION IN NUCLEON-NUCLEON COLLISIONS. E. Ferrari (CERN, Geneva) and F. Selleri. Nuovo Cimento (10), 27: 1450-83(Mar. 16, 1963). (In English)

The matrix element for the process of single pion production in nucleon-nucleon collisions is constructed under the hypothesis of a dominant contribution from the one-pion exchange term. The effects of the virtuality of the $\pi$ meson are fully taken into account. It is found that the finite size of the nucleon cannot be neglected. The method used allows the determination of the "pionic form factor" of the nucleon. It is shown that, by the choice of a form factor similar to the electromagnetic ones, agreement with experiment is obtained for incident energies of 1 to 3 Bev. For higher energies, the connection with a possible "Regge pole behavior" for such reactions is briefly discussed. (auth)

**19111** PERTURBATION THEORY OF SCATTERING OF A PARTICLE BY AN IDENTICAL BOUND PARTICLE. [PART] II. E. Corinaldesi (Iowa State Univ., Iowa City). Nuovo Cimento (10), 27: 1484-91(Mar. 16, 1963). (In English)

An exact treatment of scattering of a particle by an identical bound particle is given on the basis of the modified-Schrödinger-equation formalism. (auth)

**19112** INADEQUACY OF A SIMPLE TWO-PION APPROXIMATION TO EXPLAIN $\eta \rightarrow 3\pi$ DISTRIBUTION. B. G. Smith (Clarendon Lab., Oxford). Nuovo Cimento (10), 27: 1498-9(Mar. 16, 1963). (In English)

It is shown that the approximation in which only interactions between the charged final-state pions (in the decay $\eta \rightarrow \pi^+ + \pi^- + \pi^0$) are considered, is inadequate to explain the pion distributions and the decay matrix element. (T.F.H.)

**19113** INFORMATION ON THE PLANNED EXPERIMENTS AT THE ORSAY LINEAR ACCELERATOR. J. P. Perez Y Jorba (Ecole Normale Supérieure, Orsay, France; Faculté des Sciences, Paris; and Faculté des Sciences, Bordeaux). Onde Elec., 42: 370-9(Apr. 1962). (In French)

Several experiments possible with a linear accelerator of high energy are briefly described. Also, an outline of projects, intentions, and subjects of interest to physicists working around the Orsay Linear Accelerator is presented. Particular attention is given to description of the measurement of the polarization of the proton in elastic diffusion e-p. The experimental arrangement was adapted with some minor modifications to the study of other reactions, in particular to the photoproduction of $\pi^0$ mesons. The study of nuclear structure by inelastic diffusion of high energy electrons was also developed for the Orsay Linear Accelerator. (P.C.H.)

**19114** DISCONTINUITIES ACROSS CUTS IN THE COMPLEX ANGULAR MOMENTUM PLANE. R. G. Newton (Universitá, Rome). Phys. Letters, 4: 11-12 (Mar. 1, 1963). (In English)

If the total angular momentum is considered as a continuous complex variable, cuts whose origin is seen to be in effect with the iteration of two-body poles via the disconnected graphs are obtained by taking the matrix integral operator as the denominator $(1 + iK)$ in the S-matrix, K being the customary K-matrix. The discontinuities across the cuts are calculated explicitly. (C.E.S.)

**19115** SOME CONSEQUENCES OF UNITARY SYMMETRY MODEL. S. Okubo (Univ. of Rochester, N. Y.). Phys. Letters, 4: 14-16(Mar. 1, 1963). (NYO-10254). (In English)

Consequences of the unitary symmetry model based upon invariance of the theory under the three-dimensional unitary-unimodular group SU(3) or under the three-dimensional unitary group U(3) are investigated. A formula for the magnetic moment of baryons is derived and the electromagnetic decay modes of bosons are investigated. (C.E.S.)

**19116** TWO-PHOTON DECAY RATES OF THE $\pi^0$ AND $\eta$ MESONS. Barbara Barrett and G. Barton (Clarendon Lab., Oxford). Phys. Letters, 4: 16-18(Mar. 1, 1963). (In English)

The result of a calculation for the $\eta \rightarrow 2\nu$ decay rate that turns out to be appreciably smaller than other values previously proposed was reported. The calculation was based on a similar process $\pi^0 \rightarrow 2\nu$ that occurs predominantly through a primary virtual dissociation of the meson($\pi$) into baryon-antibaryon pairs. (C.E.S.)

**19117** THE BACKWARD PEAK IN HIGH-ENERGY n-p SCATTERING. R. J. N. Phillips (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Phys. Letters, 4: 19-20(Mar. 1, 1963). (In English)

It was pointed out that one meson($\pi$) exchange can lead indirectly to a narrow backward peak in n-p scattering at 2.04 and 2.85 Bev through interference with other contributions. When the contribution from single $\pi^\pm$ exchange is comparable to the observed cross section, rapid variation in the cross section near 180° may be expected, either from interference or simply from the rapid decrease of the single $\pi^\pm$ terms. A narrow peak is just one of many possibilities. (C.E.S.)

**19118** DIRECT MEASUREMENT OF THE $\eta^0$ DECAY INTO TWO $\gamma$. L. Behr, P. Mittner, and P. Musset (Ecole Polytechnique, Paris). Phys. Letters, 4: 22-3(Mar. 1, 1963). (In English)

A proof of the existence of the 2-photon decay of mesons ($\eta^0$) is reported. The method used consists in measuring directly by magnetic curvature in a heavy liquid bubble chamber the energy of the electrons of $\nu$ materialization. The effective mass of the two $\nu$ is easily deduced from the measured values. The reactions $\pi^- + p \rightarrow n + (2 \text{ or } 3\nu)$ produced by the 1.15 Bev/c $\pi^-$ beam of the 3-Bev Saturne synchrotron at Saclay were studied. (C.E.S.)

**19119** CANCELLING CUTS IN THE REGGE PLANE. J. C. Polkinghorne (Cambridge Univ., Eng.). Phys. Letters, 4: 24(Mar. 1, 1963). (In English)

The application of the unitary condition in crossed channels suggests the possibility of cuts in the Regge plane. An example from perturbation theory is given in which cancellations between separate terms in the unitary sum removes unwelcome singularities. (C.E.S.)

**19120** SOME REMARKS ON STATIC ELECTRIC QUADRUPOLE PERTURBATIONS IN ANGULAR CORRELATIONS. E. Matthias (Uppsala Univ.), W. Schneider, and R. M. Steffen. Phys. Letters, 4: 41-3(Mar. 1, 1963). (In English)

Features of the attenuation coefficients in the case of an electric quadrupole interaction of lower than axial symmetry and a frequency distribution due to the variations of the axially symmetric electric field gradients at the different sites of the nuclei in an imperfect crystal lattice are described. The attenuation of an angular correlation by a randomly oriented non-axial electric field gradient in a polycrystalline source is considered. The behavior of the attenuation coefficients over a large frequency range and for different relative widths of the normal distribution is investigated. (C.E.S.)

**19121** DIRECT MEASUREMENT OF $\Xi^-$ AND $\Xi^0$ MEAN LIVES. L. Jauneau (Ecole Polytechnique, Paris), D. Morellet, U. Nguyen-Khac, et al. Phys. Letters, 4: 49-51(Mar. 1, 1963). (In English)

Cascade hyperons were produced in the Ecole Polytechnique $1 \times \frac{1}{2} \times \frac{1}{2}$ m$^3$ heavy liquid bubble chamber by a beam of 1.47-Bev/c $K^-$ from the CERN synchrotron. The liquid was Freon 115. To obtain $\Xi^0$, $\Xi^-$, leptonic decays of strange particles, and double and triple strange particle events, 220,000 photos were scanned. A maximum likelihood method was employed that used as potential path length for each event the distance along the $\Xi^-$ line of flight over which the $\Lambda^0$ apex remains inside the chamber fiducial volume. The mean lines were found to be $\tau_{\Xi^-} = 1.91^{\pm} \times 10^{-10}$ sec, $\tau_{\Xi^0} = 3.9 \times 10^{-10}$ sec, and $\tau_{\Lambda^0} = 2.4^{\pm} \times 10^{-10}$ sec. (C.E.S.)

**19122** MEAN LIFE OF THE NEUTRAL PION. G. Von Dardel, D. Dekkers, R. Mermod, J. D. Van Putten, M. Vivargent, G. Weber, and K. Winter (CERN, Geneva). Phys. Letters, 4: 51-4(Mar. 1, 1963). (In English)

High energy neutral mesons($\pi$) were produced in platinum foils of 3-60 micron thickness exposed to the 18-Bev internal proton beam of the CERN proton synchrotron, and the production of positrons relative to all heavier particles was measured in a secondary beam of 5-Bev/c. The momentum spectrum of $\pi^0$, which is effective in producing 5-Bev/c positrons, is obtained by weighting the $\pi^0$ spectrum with the probability that a positron from a $\pi^0$ has a momentum of 5-Bev/c. The momentum spectra of $\pi^0$ and $\pi^+$ are assumed to be of equal shape and the latter was measured. This effective $\pi^0$ spectrum is narrow and is characterized by an average momentum of 7.12-Bev/c and a rms momentum of 7.26-Bev/c. The mean life was determined to be $(1.05 \pm 0.18) \times 10^{-16}$ sec. (C.E.S.)

**19123** ON THE RELATIONSHIP BETWEEN THE SCALE TRANSFORMATION AND THE ASYMPTOTIC REGGE-BEHAVIOUR OF THE RELATIVISTIC SCATTERING AMPLITUDE. H. A. Kastrup (Universität, Munich). Phys. Letters, 4: 56-8(Mar. 1, 1963). (In English)

Results are derived for the imaginary part of the scattering phase shift for inelastic processes at very high energies, particularly where there are relations between conformal invariance and the asymptotic Regge behavior of the relativistic scattering amplitude. (C.E.S.)

**19124** THEORETICAL NUCLEON-NUCLEON POTENTIAL. W. N. Cottingham (University Coll., London) and R. Vinh Mau. Phys. Rev., 130: 735-49(Apr. 15, 1963).

The two-pion exchange nucleon-nucleon potential is calculated on the basis of the Mandelstam representation of the field-theoretic scattering amplitude. The results contain parameters referring to low-energy pion-nucleon scattering and the renormalized coupling constant g only. A comparison of these results with phenomenological potentials is made. (auth)

**19125** USE OF RADIATIVE $\pi$ DECAY TO LIMIT THE NEUTRINO MASS. Alfred S. Goldhaber (Princeton Univ., N. J.). Phys. Rev., 130: 760-1(Apr. 15, 1963).

A limit on the $\mu$ neutrino mass may be obtained by observing radiative $\pi$ decay. If the $\gamma$ energy is measured, then a value within $\frac{3}{4}$ Mev of the maximum possible $\gamma$ energy is required to limit the neutrino mass to 1 Mev. If the coincident $\mu$ momentum is also measured, then the $\gamma$ energy must be within, say, 3 Mev of the maximum, and the $\mu$ momentum within 0.1 Mev/c of its maximum. "Useful" events for both processes occur once in about $10^8$ $\pi$ decays. (auth)

**19126** ELASTIC-DIFFERENTIAL CROSS SECTION OF $\pi^+ + p$ AT 1.5, 2.0, AND 2.5 Bev/c. Victor Cook (Univ. of California, Berkeley), Bruce Cork, William R. Holley, and Martin L. Perl. Phys. Rev., 130: 762-5(Apr. 15, 1963). (UCRL-10391)

Elastic-scattering angular distributions are measured for $\pi^+ + p$ scattering at 1.5, 2.0, and 2.5 Bev/c, using spark chambers to detect scattered pions and protons. A bump that decreases in amplitude with increasing momentum is observed in the backward hemisphere in the 1.5- and 2.0-Bev/c distributions, but is not observed in the 2.5-Bev/c distributions. It appears reasonable to attribute this phenomenon to the 1.45-Bev/c resonance observed in the $\pi^+ + p$ total cross section. The data are compared with $\pi^- + p$ data and are found to support the theoretical prediction that the scattering cross sections for both charge states should become equal at high energies. The angular distributions are fit with a power series in $\cos\theta^*$, and the extrapolated values for the scattering cross section in the backward direction are compared with the calculation of the neutron-exchange pole contribution to the cross section. The "elementary" neutron-pole term contribution is calculated to be 90 mb/sr at 2.0 Bev/c, in violent disagreement with the extrapolated value, $\approx$0.5 mb/sr. (auth)

**19127** LIFETIME OF THE $\Lambda^0$ HYPERON. M. M. Block (Northwestern Univ., Evanston, Ill.), R. Gessaroli, S. Ratti, et al. Phys. Rev., 130: 766-8(Apr. 15, 1963).

A precision measurement of the $\Lambda^0$ lifetime is made in a helium bubble chamber. An exposure to a stopping $K^-$ beam gives 2239 $\Lambda^0$'s, with a mean momentum of $\sim$250 Mev/c, which satisfy rigorous selection criteria designed to minimize biases. The mean lifetime is found to be $\tau = (2.36 \pm 0.06) \times 10^{-10}$ sec. (auth)

**19128** NEW DETERMINATION OF THE $K_1^0$ BRANCHING RATIO. John L. Brown (Univ. of California, Berkeley), John A. Kadyk, George H. Trilling, Byron P. Roe, Daniel Sinclair, and John C. Vander Velde. Phys. Rev., 130: 769-75(Apr. 15, 1963). (UCRL-10539)

Using the 12-in. xenon bubble chamber, the branching ratio of the decay modes $K_1^0 \rightarrow 2\pi^0$ and $K_1^0 \rightarrow \pi^+ + \pi^-$ is determined. Exposure of the chamber to an 800-Mev/c separated $K^+$ beam produces a large number of $K^0$ particles by charge exchange in the xenon, leading to about 3500 $K_1^0$ decays. The $K_1^0 \rightarrow 2\pi^0$ decay mode is recognized by observation of the electron pairs formed by conversion of the $\gamma$ rays from $\pi^0$ decay. From an analysis of these data, the $K_1^0$ branching ratio is determined to be $(K_1^0 \rightarrow 2\pi^0)/[(K_1^0 \rightarrow 2\pi^0) + (K_1^0 \rightarrow \pi^+ + \pi^-)] = 0.335 \pm 0.014$. This result is in agreement with the value of 0.337 predicted by the $|\Delta T| = \frac{1}{2}$ rule. (auth)

**19129** ELEMENTARY PARTICLE THEORY OF COMPOSITE PARTICLES. Steven Weinberg (Univ. of California, Berkeley). Phys. Rev., 130: 776-83(Apr. 15, 1963).

Any nonrelativistic theory may be written by introducing fictitious elementary particles with arbitrary properties. No physical predictions are affected, provided that the interaction part of the Hamiltonian is correspondingly modified. The fictitious elementary particle provides a good representation of a real composite particle if the modified interaction is sufficiently weakened for perturbation theory to work. It corresponds to a truly elementary particle with infinite bare mass, and hence with $Z = 0$. It is shown how the latter condition yields a sum rule for the coupling of a composite particle to its constituents as a function of energy. The sum rule can be used to evaluate such coupling constants as that for the proton-electron-hydrogen vertex. The mathematical method used is that developed by Schmidt for the study of the Fredholm equation, and corresponds to the extraction of a single factor from the full Fredholm determinant. (auth)

**19130** ISOTOPIC SPIN IN $K \rightarrow 3\pi$. G. Barton (Clarendon Lab., Oxford), C. Kacser, and S. P. Rosen. Phys. Rev., 130: 783-6(Apr. 15, 1963).

Because data on $K_2^0 \rightarrow \pi^+\pi^-\pi^0$ are at variance with the $\Delta T = 1/2$ rule while the data on $K^+ \rightarrow 3\pi$ are not, the charge space kinematics of $K \rightarrow 3\pi$ are examined. Matrix elements are assumed to be at most linearly dependent on the variables $s_i$, and it follows that only four of the seven possible $3\pi$ states can contribute to the decay. Of these states, two have $T = 1$, the third has $T = 2$ and the fourth $T = 3$. The possible values of $\Delta T$ are $\frac{1}{2}$, $\frac{3}{2}$, $\frac{5}{2}$, $\frac{7}{2}$, and accordingly,

the most general interaction Hamiltonian is written as the sum of four parts $H_{n/2}$, each corresponding to $\Delta T = n/2$ ($n = 1, 3, 5, 7$). It is then possible to express the matrix elements, rates and spectra of all the modes of $K \rightarrow 3\pi$ in terms of the reduced matrix elements of $H_{n/2}$ between the four $3\pi$ states and the K meson. The analysis reveals that, provided the branching ratio of $K_2^0 \rightarrow 3\pi^0$ to $K_2^0 \rightarrow \pi^+\pi^-\pi^0$ is $3/2$, the data are consistent with an interaction Hamiltonian containing only $\Delta T = 1/2$ and $3/2$, and a $3\pi$ final state of isotopic spin one. (auth)

**19131** STRANGE PARTICLE PRODUCTION BY 4.65-Bev/c $\pi^-$ MESONS. L. Bertanza (Brookhaven National Lab., Upton, N. Y.), B. B. Culwick, K. W. Lai, I. S. Mittra, N. P. Samios, A. M. Thorndike, S. S. Yamamoto, and R. M. Lea. Phys. Rev., 130: 786-90(Apr. 15, 1963). (BNL-6573)

Hydrogen bubble chamber photographs taken in an unseparated 4.65-Bev/c $\pi^-$ beam at the Brookhaven alternating gradient synchrotron give partial cross sections for many channels involving associated production of Y + K and production of K pairs. Associated production channels total 1.11 mb, K pair channels 0.57 mb. Most channels involve one or more pions in the final state. Peripheral collisions appear important for such processes. The only resonance clearly observed is $K^*$ with the mass of 895 Mev. (auth)

**19132** HIGH-ENERGY BEHAVIOR OF SCATTERING AMPLITUDES IN QUANTUM ELECTRODYNAMICS. Maurice Levy (Inst. for Advanced Study, Princeton, N. J.). Phys. Rev., 130: 791-800(Apr. 15, 1963).

The perturbation expansion of the elastic electron-electron scattering amplitude is examined in the limit of very high energy and finite momentum transfer (nearly forward scattering). Several classes of graphs involving the exchange of an arbitrary number of virtual photons are summed into an exponential form, but no evidence is found that the exponent contains terms depending logarithmically upon the energy with coefficients varying with the momentum transfer. This leads to the conclusion that the photon is probably not a "Regge pole." Its zero mass and its vector character are seen to be together responsible for this result. A symmetry property of the elastic scattering amplitude shows that terms involving the exchange of an even number of virtual photons do not, in any case, contribute at very high energy in the neighborhood of the forward direction. (auth)

**19133** TWO VACUUM POLES AND PION-NUCLEON SCATTERING. Keji Igi (Univ. of California, Berkeley). Phys. Rev., 130: 820-7(Apr. 15, 1963).

A general expression is given for the pion-nucleon non-charge-exchange scattering amplitude for arbitrary energy and small momentum transfer on the assumption that only the vacuum pole P and the second vacuum pole P′ exist in the upper half J plane. Sum rules are derived or non-slip-flip and spin-flip amplitudes, and are used, combined with the analysis of the high-energy $\pi$-N cross sections in terms of Regge poles, to investigate the behavior of P and P′ trajectories near $t \approx 0$. For this purpose the importance of a precise measurement of the low-energy partial-wave phase shifts is emphasized. A sum rule for the S-wave pion-nucleon non-charge-exchange scattering length can be satisfied with $\alpha_{P'} \approx 0.5$. (auth)

**19134** NUCLEON FORM FACTORS IN THE STRONG-COUPLING MESON THEORY. R. Morita (Columbia Univ., New York). Phys. Rev., 130: 833-46(Apr. 15, 1963).

Expressions for the electric form factors of the proton and neutron are given in the charged-scalar and symmetrical pseudoscalar meson theories. Calculations are done in the strong-coupling limit. Both theories explain the experimental data given by the Stanford and Cornell groups very well. In the pseudoscalar theory, however, an effective meson mass must be used that is about one-half of the rest mass. Small effective mass can be understood if a cubic term is introduced in the equation of motion for mesons. In the numerical integration of this equation, the strength $g\sqrt{\lambda}$ is obtained from the boundary conditions, g and $\lambda$ being the coupling constants of the pion-nucleon and pion-pion fields, respectively. With numerical solutions, the nucleon form factors are recalculated. These factors fit the experimental data quite well. (auth)

**19135** PRECISION MEASUREMENT OF THE g FACTOR OF THE FREE ELECTRON. D. T. Wilkinson and H. R. Crane (Univ. of Michigan, Ann Arbor). Phys. Rev., 130: 852-63(May 1, 1963).

Refinement of an earlier measurement is given in which the g factor was found to ±2.4 parts in $10^6$. The method is as follows: 100-kev electrons in 0.2-$\mu$sec bunches move parallel to a magnetic field and strike a gold foil. The part of an electron bunch that is scattered at right angles, and that, consequently, is partially polarized, is trapped in the magnetic field and held for a measured length of time (up to 1.9 msec). The bunch is then released from the trap and allowed to strike a second gold foil. The cycle is repeated 500 times per sec. The part of the bunch scattered at right angles by the second foil strikes a thin-window Geiger counter. The fraction of the bunch scattered into the counter depends upon its final direction of polarization. A plot of the intensity vs trapping time is a cosine curve whose frequency is the difference between the orbital frequency and the spin precession frequency. The present experiment is an advance over the earlier one in four main respects: separation of the polarization effect from the background, electrostatic effects, magnetic field, the beginning of the measured trapping interval was moved out to about 300 $\mu$sec after injection and a time difference method was used. The final result is $a = 0.001\ 159\ 622 \pm 0.000\ 000\ 027$. In terms of a series in the fine structure constant, the experiment gives $a = \alpha/2\pi - (0.327 \pm 0.005)\alpha^2/\pi^2$ and theory gives $a = \alpha/2\pi - 0.328\alpha^2/\pi^2$ where $g = 2(1a)$. (auth)

**19136** POLARIZATION OF NEUTRONS FROM THE PHOTODISINTEGRATION OF DEUTERIUM. David E. Frederick (Univ. of Illinois, Urbana). Phys. Rev., 130: 1131-9(May 1, 1963).

The polarization of neutrons photoproduced from deuterium at about 148° in the center-of-mass system was measured at four intervals in the photon energy range of 12.0-22.9 Mev in the laboratory system. The neutron polarization was analyzed in a low-pressure helium diffusion cloud chamber by scattering the neutrons and observing the left-right asymmetry in the helium gas nuclear recoils. This was achieved by photographing the individual recoils on film, then making measurements on the stereoscopically projected recoil track images, and finally subjecting the data to a maximum likelihood calculation. The flash photography of the random-scattering events was controlled by a photoelectric detection system: The cloud chamber was illuminated continuously with a slide projector light beam and a photomultiplier detected the reflected light from the formation of a densely ionizing track. The polarizations measured in the four photon-energy intervals of 12.0–12.9 Mev, 13.0–15.9 Mev, 16.0–17.9 Mev, and 18.0–22.9 Mev are $-0.149 \pm 0.100$, $-0.198 \pm 0.086$, $-0.254 \pm 0.120$, and $-0.295 \pm 0.137$, respectively. The polarization is defined to be positive in the direction of $k_\gamma \times k'_{n0}$ the directions of the incoming photon and outgoing photoneutron, respectively.

The results are substantially in agreement with the polarization calculations by deSwart and Marshak and by Rustgi, Zernik, Breit, and Andrews. (auth)

**19137** NEW LIMIT FOR ISOTOPIC SPIN CONSERVATION IN STRONG INTERACTIONS FROM AN EXPERIMENTAL LIMIT ON $\sigma(d + d \rightarrow He^4 + \pi^0)$. John A. Poirier and Morris Pripstein (Univ. of California, Berkeley). Phys. Rev., 130: 1171-7(May 1, 1963). (UCRL-10533)

The strong reaction $d + d \rightarrow He^4 + \pi^0$, which is forbidden by isotopic spin conservation, was looked for with a 460-Mev deuteron beam from the Berkeley 184-in. cyclotron. Preliminary results were reported elsewhere. A more comprehensive analysis of this same experiment was recently completed. From this analysis, an upper limit for the differential cross section for the reaction in the c.m. system at about $\Theta_{c.m.} = 90°$ is found to be $(0.097 \pm 0.027) \times 10^{-33}$ cm$^2$/sr. The data are consistent with no $\pi^0$ production. From a comparison of this upper limit with the theoretical prediction of the cross section for this reaction if isotopic spin need not be conserved, it is concluded that isotopic spin is at least (99.74 ± 0.08)% conserved in this strong interaction. (auth)

**19138** THEORY OF THE J = 3/2, I = 3/2 πN RESONANCE. Virendra Singh (California Inst. of Tech., Pasadena) and Bhalchandra M. Udgaonkar. Phys. Rev., 130: 1177-9(May 1, 1963).

The position $W_R$ and width $\gamma_{33}$ of the J = 3/2, I = 3/2 P-wave πN resonance are calculated using partial-wave dispersion relations. The nucleon and meson ($\mu$) masses and coupling constants, which determine the long-range part of the forces, are treated as given. The parameters that characterize the distant part of the left-hand cut are fixed by using the expressions for the (3/2,3/2) P-wave πN state given by fixed energy dispersion relations in a region where they are valid without subtractions in a way used by Balázs for the ππ problem. The self-consistency demand that the position and width of the (3/2,3/2) resonance used as input values in the crossed channel in the fixed-energy dispersion relation be the same as the calculated values of the position and width is imposed. The preliminary results of the calculation are $W_R \approx m + 2.35$ and $\gamma_{33} \approx 0.14$. The experimental values are $W_R = m + 2.17$ and $\gamma_{33} \approx 0.12$ (where m is the nucleon mass). These results constitute the first part of the intended self-consistent calculation of the nucleon mass and (3/2,3/2) resonance position, exploiting the reciprocal bootstrap mechanism discussed by Chew. (auth)

**19139** NONLEPTONIC DECAYS OF HYPERONS. Suraj N. Gupta (Argonne National Lab., Ill.). Phys. Rev., 130: 1180-1(May 1, 1963). (TID-17420)

A simple model of the nonleptonic decays of hyperons is discussed, in which weak interactions occur only through the two-baryon vertices. The model is in agreement with the main features of Σ and Λ decays, and leads to pion coupling constants of the same sign and nearly the same magnitude. (auth)

**19140** SCATTERING OF 19.2 Gev/c PROTONS ON FREE PROTONS IN NUCLEAR EMULSION. V. A. Bull and D. A. Garbutt (Univ. of London). Phys. Rev., 130: 1182-7 (May 1, 1963).

An experimental study was made of the elastic scattering of protons by free protons at a laboratory momentum of 19.2 Bev/c. The proton beam was directed at perpendicular incidence into water-loaded nuclear emulsions that were used as both target and detector. For elastic p-p scattering the total cross section was found to be 9.4 ± 1.3 mb. At zero angle the measured value of the differential cross section was higher than that predicted by the optical theorem, indicating the existence of a real part of the forward scattering amplitude or a spin dependence of the total proton-proton cross section. An analysis of other experimental data above 2.5 Bev is presented confirming the above result and is compared with the predictions of a Regge-pole model at zero angle. (auth)

**19141** ELECTROMAGNETIC CORRECTIONS TO WEAK INTERACTIONS. THE BETA DECAYS OF THE MUON, NEUTRON, AND $O^{14}$. Loyal Durand, III (Brookhaven National Lab., Upton, N. Y. and Yale Univ., New Haven), Leon F. Landovitz, and Robert B. Marr. Phys. Rev., 130: 1188-1209(May 1, 1963). (BNL-6539)

The momentum-dependent radiative corrections to the beta decays of the meson ($\mu$), the neutron, and $O^{14}$ was calculated to order $\alpha$ using the techniques of dispersion theory. The transition matrix elements can be expressed to this order (neglecting some effects of strong interactions) in terms of sets of vertex functions that satisfy once-subtracted dispersion relations. The absorptive parts of the vertex functions can be expressed to the appropriate order in terms of the vertex functions themselves and the amplitudes for electromagnetic scattering of the charged particles. It is a curious feature of the present calculation that the choice of the subtraction points is not arbitrary, but is determined uniquely by the requirement that such physically significant quantities as decay rates and the momentum spectra of the leptons should contain no infrared divergences when calculated including the contributions of processes in which soft photons are emitted [inner bremsstrahlung]. The subtraction constants play the role of renormalized weak coupling constants. The significance of this electromagnetic renormalization, and the connection between the choice of the subtraction point and the infrared divergence is examined in detail in the case of the meson ($\mu$). Two models for the beta decay of $O^{14}$ were considered. The results obtained from the two models differ only slightly. Because of the appearance in the absorptive parts of the vertex functions of the form factors of the charged particles, evaluated for the particles on the mass shell, the effects on the transition amplitude of the finite electromagnetic structure of the nuclei are studied. The effects of the finite spacial distribution of the decaying matter are treated using the usual multipole expansion of the nuclear matrix element. The leading electromagnetic structure correction is of the same form as the familiar $Z\alpha RW$ in the correction for finite nuclear structure (finite deBroglie wavelength effect), but is of a different origin, and leads to a near doubling of the total structure corrections. The known theoretical corrections to the decay rates for the 0+ → 0+ transitions $O^{14}(\beta^+)N^{14*}$, $Al^{26*}(\beta^+)Mg^{26}$, and $Cl^{34}(\beta^+)S^{34}$ are summarized. Using the recent, very accurate data on the decays of the meson ($\mu$), $O^{14}$, and $Al^{26*}$, we obtain the values $G_\mu = (1.436 \pm 0.001) \times 10^{-49}$ erg cm$^3$, $G_\beta(O^{14}) = (1.419 \pm 0.002) \times 10^{-49}$ erg cm$^3$, and $G_\beta(Al^{26*}) = (1.430 \pm 0.002) \times 10^{-49}$ erg cm$^3$ for the renormalized vector coupling constants for these transitions. The less accurate data on the neutron yield $G_V = (1.356 \pm 0.068) \times 10^{-49}$ erg cm$^3$. The results for $G_\mu$ and $G_\beta$ are not directly comparable in the present theory, but the different values of $G_\beta$ should be. The discrepancy of (0.8 ± 0.5)% between the effective coupling constants for the decays of $O^{14}$ and $Al^{26*}$ could, therefore, be significant, and may yield information about the still uncertain Coulomb corrections to the nuclear matrix elements. If the validity of the cutoff-dependent results of perturbation theory is assumed, the renormalization constants can be evaluated, and one obtains $G_{\mu,bare} = (1.431 \pm 0.001) \times 10^{-49}$ erg cm$^3$ and $G_{\beta,bare}(O^{14}) = (1.404 \pm 0.007) \times 10^{-49}$ erg cm$^3$. Those coupling constants differ by 1.9 ± 0.2%, but because of un-

certainties regarding the nuclear matrix element $O^{14}$, the effects of strong interactions, and the possible existence of an intermediate vector meson which mediates the weak interactions, a direct comparison of these numbers may not be relevant to the possible universality of the Fermi interaction. (auth)

**19142** RADIATIVE CORRECTIONS TO HIGH-ENERGY SCATTERING PROCESSES. N. Meister (Laboratoire de Physique Théorique et Hautes Energies, Orsay, France) and D. R. Yennie. Phys. Rev., 130: 1210-29(May 1, 1963).

A unified treatment of radiative corrections to a class of scattering experiments is presented. The experiments considered are those in which either (but not both) the scattered or recoil particle is detected. The recoil kinematics are properly treated and the calculation is simplified by retaining only terms of logarithmic order. The general results are applied to specific practical examples in which radiative corrections are likely to be important. Except possibly for the case of Compton scattering with nearly maximum or nearly minimum momentum transfer, the errors are estimated to be less than 2% of the cross section. (auth)

**19143** PARTIAL-WAVE BETHE-SALPETER EQUATION. Noboru Nakanishi (Inst. for Advanced Study, Princeton, N. J.). Phys. Rev., 130: 1230-5(May 1, 1963).

The Bethe-Salpeter equation for higher-wave bound states of two scalar particles is investigated in the ladder approximation. It is shown that all solutions have the Deser-Gilbert-Sudarshan-Ida integral representation and that they behave like $0[(p^2)^{-l-2}]$ as $p^2 \to \infty$ apart from a solid harmonic. The angular momentum l is continued to complex values, and it is proved that the wave functions are essentially holomorphic with respect to l in Re $l > -1/4$. The equation for the Regge trajectories is also discussed. (auth)

**19144** BACKSCATTER FROM INHOMOGENEOUS MEDIA. P. J. Lynch (Space Tech. Labs., Inc., Redondo Beach, Calif.). Phys. Rev., 130: 1235-43(May 1, 1963).

A WKB approximation is used to calculate cross sections for the 180° scattering of scalar and vector waves by a class of spherically symmetric, repulsive potentials. These potentials are such that the corresponding index of refraction has a unique zero. The scalar problem is discussed in the framework of quantum mechanics, and the result is just the classical cross section. Electromagnetic backscatter from a dielectric is found to be three-quarters of the scalar approximation in the extreme geometrical-optics limit. (auth)

**19145** REGGE POLES IN RELATIVISTIC WAVE EQUATIONS. G. S. Guralnik (Harvard Univ., Cambridge, Mass.). Phys. Rev., 130: 1259-64(May 1, 1963).

Solutions of the relativistic wave equation for three different coupling schemes to an external source are examined. The Regge trajectories are observed to exhibit a high degree of model dependence and to possess singularities that are often assumed absent in a fully relativistic theory. It is shown that these arise from multiple poles in the scattering amplitude and can occur in theories for which no collapse into the center is possible for physical values of the angular momentum. (auth)

**19146** ARTIFICIAL SINGULARITY IN THE N/D EQUATIONS OF THE NEW STRIP APPROXIMATION. Geoffrey F. Chew (Univ. of California, Berkeley and Cambridge Univ., Eng.). Phys. Rev., 130: 1264-7(May 1, 1963). (UCRL-10593)

The singularity introduced artificially into the equations of the new strip approximation, in order to bridge the gap between low and high energies, is investigated in detail. By explicit construction, it is shown that a necessary and sufficient condition for a (unique) solution of the N/D equations to exist is that the unitarity constraint on the cross section just above the strip boundary should be obeyed. The only singularities of the solution in the right-half angular momentum plane (Re J ≥ 0) are Regge poles. (auth)

**19147** DISPERSION RELATION FOR THE REGGE PARAMETERS. Hung Cheng (California Inst. of Tech., Pasadena). Phys. Rev., 130: 1283-6(May 1, 1963).

The Regge parameters $\alpha(s)$ and $\beta(s)$ of trajectories that cross one another at some point $s_0$ are proved to form different branches of an analytic function with the branch point at $s_0$. A new set of Regge parameters is found that are regular in the neighborhood of $s_0$. Dispersion relations written for these parameters thus take a simple form and should be the ones to use for the dynamical determination of the Regge parameters. In the example of nonrelativistic scattering by a superposition of Yukawa potentials, crossing of trajectories is shown to happen for an infinite number of Regge trajectories. A method to obtain the asymptotic series of $\alpha(s)$ and $\beta(s)$ for large s, is given in the nonrelativistic case, and from this it is shown that in the potential all $\alpha(s)$ and $\beta(s)e^{-i\pi\alpha(s)}$ are real analytic functions of s. (auth)

**19148** RENORMALIZABLE ELECTRODYNAMICS OF VECTOR MESONS. Abdus Salam (Imperial Coll., London). Phys. Rev., 130: 1287-90(May 1, 1963).

It is shown that the conventional theory of charged spin-one mesons interacting with photons can be renormalized provided meson mass m and charge e are restricted by the relation $Z(m^2,e^2) = 0$, where Z is the meson wave-function renormalization constant. (auth)

**19149** REMARKS CONCERNING THE RECENT HIGH-ENERGY NEUTRINO EXPERIMENT. G. Danby, J.-M. Gaillard, K. Goulianos, L. M. Lederman, T. D. Lee, N. Mistry, M. Schwartz, and J. Steinberger (Columbia Univ., New York and Brookhaven National Lab., Upton, N. Y.). Phys. Rev. Letters, 10: 260-2(Mar. 15, 1963).

A previous experiment indicated that if the reactions $\nu_e + n \to p + e^-$ and $\bar{\nu}_e + p \to n + e^+$ have cross sections comparable to those of $\nu_\mu + n \to p + \mu^-$ and $\bar{\nu}_\mu + p \to n + \mu^+$, then $\nu_e$ is most likely different from $\nu_\mu$. It is pointed out that an absolute theoretical lower limit could be established for the rates of the $e^\pm$-producing reactions without a relative comparison with that of the $\mu^\pm$-producing reactions by assuming the conserved vector-current hypothesis. The possible existence of an intermediate boson and the possibility that the reactions are actually second order processes mediated by the exchange of such a boson are considered. (C.E.S.)

**19150** STRUCTURE IN THE PION-PROTON TOTAL CROSS SECTION BETWEEN 2 AND 3 Bev. A. N. Diddens, E. W. Jenkins, T. F. Kycia, and K. F. Riley (Brookhaven National Lab., Upton, N. Y.). Phys. Rev. Letters, 10: 262-5(Mar. 15, 1963). (BNL-6760)

The total cross sections for $\pi^\pm$ on protons in the energy range from 1.5 to 6 Bev were measured in a transmission experiment. The data were taken in small energy steps and with a statistical accuracy of about 1%. The results indicate two statistically significant and previously unreported pion-nucleon resonances, one in each of the two isotopic spin states. The resonances occur at 2.19 and 2.36 Bev with isotopic spins of $1/2$ and $3/2$, respectively. (C.E.S.)

**19151** SOME EMPIRICAL SYSTEMATICS OF THE PION-NUCLEON SYSTEM. T. F. Kycia and K. F. Riley (Brookhaven National Lab., Upton, N. Y.). Phys. Rev. Letters, 10: 266-7(Mar. 15, 1963). (BNL-6761)

Several empirical systematics of the quantum numbers and masses of the nuclear excited states in meson($\pi$)-nucleon resonances are given. A possible selection rule is suggested. The representation of the nucleon isobars presented are based upon purely empirical rules that may lead to a better understanding of the meson($\pi$)-nucleon interaction. (C.E.S.)

**19152** ABSORPTION, POLARIZATION PHENOMENA, AND TWO-BARYON INTERACTIONS. Norio Hoshizaki and Shigeru Machida (Kyoto Univ. and Rikkyo Univ., Tokyo). Progr. Theoret. Phys. (Kyoto), 29: 44-8(Jan. 1963). (In English)

A study is made of polarization effects in high-energy scattering. Consideration in the limiting case of complete absorption, or of the absence of real phase shifts, leads to the possibility of obtaining information on two-baryon elastic interactions from polarization experiments at high energies. An approach to two-baryon interactions at close distance is briefly described. (auth)

**19153** p-p SCATTERING AT 660 Mev. Norio Hoshizaki and Shigeru Machida (Kyoto Univ. and Rikkyo Univ., Tokyo). Progr. Theoret. Phys. (Kyoto), 29: 49-59(Jan. 1963). (In English)

A method is presented for analyzing data on nucleon-nucleon scattering in the energy region where absorption processes cannot be neglected. The imaginary parts of the phase shifts are estimated from data on pion production with the use of the (3/2,3/2) resonance model. Secondly the scattering data are analyzed to obtain real phase shifts. The search is made for real phase shifts in the phase-shift space, which is restricted by extrapolating the solution established below about 400 Mev. An analysis is made, according to this scheme, for p-p scattering at 660 Mev. The absorption occurs mainly in the initial P, D, and F states. Data on elastic differential cross section, polarization, and depolarization can be reproduced by a set of phase shifts that is smoothly connected with a particular solution below about 400 Mev. The measured $C_{nn}(90°)$ and $C_{KP}(90°)$ values are also consistent with those predicted by the solution obtained. (auth)

**19154** THE EFFECTS OF THE TWO BIPION RESONANCES ON LOW ENERGY MESON-NUCLEON SCATTERING. Tetsuya Tsuchida (Ibaragi Univ., Mito, Japan). Progr. Theoret. Phys. (Kyoto), 29: 60-70(Jan. 1963). (In English)

Some aspects of pion-nucleon scattering are investigated by taking into account the two bipion I = 1 resonances $\zeta$ and $\rho$. With a choice of parameters fixed by empirical data on the nucleon form factors, S-wave and small P-wave phase shifts can be obtained that are consistent with experimental data up to 400 Mev. It is shown that the bipion resonance is necessary to reproduce the empirical data of the above partial waves. Further, it is emphasized that nucleon recoil is not negligible even at low energies. (auth)

**19155** A CLASSIFICATION OF RESONANCES — WITH RE-EXAMINATION OF BALL-FRAZER FORMULA. Yasunori Fujii (Nihon Univ., Tokyo). Progr. Theoret. Phys. (Kyoto), 29: 71-86(Jan. 1963). (In English)

The Ball Frazer formula (Phys. Rev. Letters, 7: 204 (1961)) is examined. A similar but somewhat different formula is derived, neglecting the contribution from the left-hand cut. In connection with this formula a classification of the mechanism of resonances is attempted, by considering different behaviors if the coupling between channels is switched off. (auth)

**19156** USE OF THE GENERALIZED JOST FUNCTION IN QUANTUM FIELD THEORY — AN EXTENSION OF THE LEVINSON THEOREM. Takeshi Kanki (Osaka Univ.). Progr. Theoret. Phys. (Kyoto), 29: 87-96(Jan. 1963). (In English)

The structure of the S-matrix is investigated in terms of the so-called generalized Jost function. Starting from the partial wave dispersion relation, the analytic properties of this function can be derived in the single-channel scattering, and it is shown that there exists a close connection between the analyticity of this function and the generalized Levinson relation. In the case where the one-particle singularity in scattering amplitudes is caused by the elementary particle, the corresponding Jost function has a pole, while in the case where this singularity is caused by the composite (bound) state, the Jost function does not have the pole. Singularities corresponding to the Castillejo-Dalitz-Dyson ambiguity are completely separated. Thus, by making the conjecture that the analyticity in the low-momentum region still remains in the multichannel case, the Levinson theorem can be extended to the multichannel case and to the S-matrix theory where the Hamiltonian is not used explicitly. A new representation of the S-matrix, and how the structure of the S-matrix changes according to each case mentioned above, is clarified. (auth)

**19157** RESTRICTION ON THE COUPLING CONSTANT FROM ANALYTICITY AND UNITARITY OF THE S-MATRIX. Takeshi Kanki and Takesi Ogimoto (Osaka Univ.). Progr. Theoret. Phys. (Kyoto), 29: 97-103(Jan. 1963). (In English)

Two ways of restricting the coupling constant are considered; one is based on the "product representation" of the S-matrix, and the other on the analytic properties of the "Jost function." The former gives only a certain inequality to the value of the coupling constant, and it becomes indefinite within the interval allowed, while the latter, in the case when the relevant pole arises from a composite particle, gives a definite value of the coupling constant, but in the case when the pole arises from an elementary particle the value of the coupling constant becomes indefinite within the interval allowed. The connection between the two methods is also discussed. (auth)

**19158** TOWARDS UNIFIED AND CONVERGENT THEORY OF ELEMENTARY PARTICLES — QUANTUM FIELD THEORY WITH INDEFINITE METRIC. Sho Tanaka (Kyoto Univ.). Progr. Theoret. Phys. (Kyoto), 29: 104-27(Jan. 1963). (In English)

In order to get rid of the divergence difficulty in the quantum field theory, fictitious particles with an indefinite metric are introduced. The difficulty concerning the probabilistic interpretation caused by the indefinite metric is satisfactorily avoided by making use of the "instability" of fictitious particles, characterized by the complex poles. Based on such a general possibility, the Nagoya model is investigated assuming B-matter to be a unified assembly of fictitious particles. (auth)

**19159** NEW CHARACTERISTICS OF MULTIPLE MESON PRODUCTION. Shun-ichi Hasegawa (Tokyo Univ.). Progr. Theoret. Phys. (Kyoto), 29: 128-54(Jan. 1963). (In English)

Multiple meson production in extremely high-energy nuclear interactions is analyzed, from experimental data of high-energy jets. A definite number of a new sort of quantum is emitted, and it is supposed to convert itself subsequently into several mesons. The basic nature of this new quantum is obtained as follows: the mass of quantum is about $2Mc^2$ ($Mc^2$ is the nucleon mass), and it decays into secondary mesons by dipole-type radiation, when the polarization axis is in the incident direction. Lorentz factor of

emitted quantum in c.m.s. of the collision shows a certain regularity, which seems to correspond to a type of quantization. As one of the possibilities of understanding these characteristics, a concept is introduced, that is, a "constant virtuality," a constant transfer of virtual four-momenta between emitted quanta, and between nucleon and quantum. The distribution of virtuality is examined in the experimental data using kinematics just mentioned. The mean value of virtuality appears to be 1 Bev/c. (auth)

**19160** ON THE CLASSICAL THEORY OF THE ELECTRON. V. Unt. Tr. Inst. Fiz. i Astron., Akad. Nauk Est. SSR, No. 19, 71-9(1962). (In Russian)

A hypothesis is proposed that gravitational forces always have attractive character. It is shown that the electron's field mass is finite and equal to its total mass from this hypothesis in the general theory of relativity. At the same time the significance of components of metric tensor in the case of a static spherically symmetric electromagnetic field is discussed. (auth)

**19161** INFLUENCE OF INTERMEDIATE VECTOR BOSON ON MUON DECAY ELECTRONS ENERGY SPECTRA. L. Palgi. Tr. Inst. Fiz. i Astron., Akad. Nauk Est. SSR, No. 19, 100-3(1962). (In Russian)

The influence of the non-locality due to an intermediate vector boson on the Michel parameter is considered. (auth)

**19162** INTERACTION-DEPENDENT CLASSIFICATION OF ELEMENTARY PARTICLES. J. (Ya.) Lõhmus (Lykhmus) and H. (Kh.) Õiglane (Yiglane). Tr. Inst. Fiz. i Astron., Akad. Nauk Est. SSR, No. 19, 113-23(1962). (In Russian)

An hypothesis is proposed that the classification of elementary particles essentially depends on the interaction in which they take part. The classifications of weak four-fermion, electromagnetic, and strong interaction of elementary particles are built on the basis of six-dimensional internal space, possessing alternative character in the sense that exact determination of one classification excludes exact determination of other classifications. The interaction Lagrangian is, in all cases, constructed as an invariant expression (scalar) under the corresponding transformations of internal space. This means, for example, that conservation of weak interaction quantum numbers takes place in the processes of weak interaction but, not in general, in the processes of other interactions. (auth)

**19163** ON INTERPRETATION OF THE PROCA EQUATION. G. B. Kutuzova. Tr. Inst. Fiz. i Astron., Akad. Nauk Est. SSR, No. 19, 124-31(1962). (In Russian)

Non-relativistic and ultra-relativistic approximations to the quantum-mechanical Proca-Kemmer-Duffin equation are considered. A conclusion is drawn that this equation can describe a particle with spin 0 in a five-rowed case and with spin 1 in a ten-rowed case only in non-relativistic approximation. In the case of relativistic velocities some states with other spins are added: in a five-rowed case with spin 1 and in a ten-rowed case with spins 0 and 1. (auth)

**19164** ON TRANSFORMATIONAL PROPERTIES OF $\beta$-MATRICES. A. Ainsaar and H. (Kh.) Õiglane (Yiglane). Tr. Inst. Fiz. i Astron., Akad. Nauk Est. SSR, No. 19, 132-40(1962). (In Russian)

Proceeding from the Proca-Kemmer-Duffin equation and the fundamental properties of $\beta$-matrices, transformational properties of expectation values for all independent products of $\beta$-matrices were obtained. It turns out that some basic matrices introduced by Umezawa have tensorical dimensionality. A new basis free from this defect was constructed. It is pointed out that there are no pseudoscalar matrices in the Kemmer-Duffin theory and the hamiltonians for the four-boson, three-boson, and two-boson-two-fermion interactions are given. (auth)

**19165** EMISSION IN MAGNETIC MONOPOLE MEDIA. A. A. Kolomenskii. Vestn. Mosk. Univ., Ser. III, Fiz. Astron., No. 6, 56-8(Nov.-Dec. 1962). (In Russian)

Characteristics of Vavilov-Cherenkov radiation and longitudinally polarized wave excitation induced by moving particles were studied for the case of particles with magnetic charge. (R.V.J.)

**19166** TWO-PARTICLE APPROACH FOR A FERMION SYSTEM WITH ATTRACTIVE INTERACTION. Erich Karl Maschke and Wolfgang Wild (Technische Hochschule, Munich). Z. Physik, 172: 314-37(1963). (In German)

For a system of fermions with short range attractive interaction, the sequence of differential equations for the Green's functions is broken off by using the Martin-Schwinger approximation for the six point function. The solution for the ground state of the system yields the momentum distribution and the spectrum of bound pairs. The latter is to be interpreted as the spectrum of collective excitations. The limits of applicability of the approximation are discussed. (auth)

**19167** SPIN EFFECT ON THE POSITION OF REGGE POLES. Ya. I. Azimov (Ioffe Inst. of Physics and Tech., Lenningrad). Zh. Eksperim. i Teor. Fiz., 43: 2321-4(Dec. 1962). (In Russian)

An accumulation of poles in the l-plane [$l = -(3n - 5)/2$], found by V. N. Gribov et al. (Phys. Rev. Lett., 9: 239(1962)), imposes a certain limitation on the asymptotic behavior of scattering amplitudes. The effects of particle spin on the position of the accumulations were analyzed using the simple case of two neutral spinless particles ($\pi$ mesons) in which spin particles (nucleon pairs) appear at an intermediate stage. The amplitude near the particle production threshold is proportional to $p^l$, where p is particle production momentum, l is the orbital moment. The l magnitude depends on the orbital $\pi$-meson moment J and the total particle spin. The minimum value of l is $J - 2\sigma$, where $\sigma$ is the spin of each particle. The analysis indicates accumulation of poles at $J = -\frac{1}{2} + 2\sigma$. Thus, the accumulation appears in spinless particle scattering amplitudes and all amplitudes related to it by a unitarity condition. Similarly, the n-particle production threshold for identical spins $\sigma$ leads to pole accumulations at $J = -(3n - 5)/2 + n\sigma$. The case of intermediate $N-\bar{N}$ pairs was analyzed as a case of pole accumulation at arbitrary energy. In the first postulation relativistic theory considering high particle spin posed certain difficulties, however, elementary particles do not possess spins larger than a 1. Higher spins can be found in nuclei, however, data on nuclear amplitude anomalies are not yet sufficient. The second postulation is more detailed, and it is possible that the liquidation of accumulations could be achieved without special conditions. It was also observed that due to the gradient invariability the two-photon intermediate state does not result in accumulations either in the 1 or in 0. (R.V.J.)

**19168** MULTIPLE $\pi$-MESON PRODUCTION IN 7.2 Bev $\pi^-$p-COLLISIONS. M. S. Ainutdinov, S. M. Zombkovskii (Zombkovsky), S. Ya. Nikitin, Ya. M. Selektor, and V. N. Shulyachenko. Zh. Eksperim. i Teor. Fiz., 44: 413-20(Feb. 1963). (In Russian)

Multiple production of $\pi$ mesons in $\pi^-$p collisions is in-

vestigated for 7.2-Bev primary $\pi$ meson energies. The measurements are performed with a liquid hydrogen bubble chamber. Angular and momentum distributions of $\pi$ mesons and protons are presented for stars of different multiplicities. The existence of bound states with energies above 1 Bev is investigated for three- and four-meson systems. (auth)

**19169** INTERACTIONS BETWEEN 7.5 Bev $\pi$-MESONS AND NUCLEONS AND THEIR ANALYSIS ON BASIS OF POLE DIAGRAMS. A. Kh. Vinitskii (Vinitsky), I. G. Golyak, V. I. Ruskin, and Zh. S. Takibaev (Inst. of Nuclear Physics, Kazakh SSR). Zh. Eksperim. i Teor. Fiz., 44: 424-30(Feb. 1963). (In Russian)

Results of a study of 200 inelastic pion-nucleon interaction events are presented. The angular and momentum characteristics of the secondary particles are presented. The pion angular distributions are asymmetric and are peaked in the forward direction; the nucleon distribution is peaked in the backward direction. In stars with a few prongs the pion and nucleon momentum curves have two peaks. Angular correlations between two pions are derived. The experimental data are analyzed from the standpoint of pole diagrams describing interactions involving one-, two-, and three-pion systems. The diagrams considered can explain about a third of inelastic pion–nucleon interaction events in which only a few prongs are formed. (auth)

**19170** INVESTIGATION OF $\Lambda$-HYPERON AND $K^0$-MESON PRODUCTION EVENTS IN $\pi^-$p-INTERACTIONS AT ENERGY OF 7-8 Bev. V. A. Belyakov, Yung-chang Wang, V. I. Seksler, et al. (Joint Inst. for Nuclear Research, Dubna, USSR). Zh. Eksperim. i Teor. Fiz., 44: 431-43 (Feb. 1963). (In Russian)

Momentum and angular distributions of $\Lambda$ hyperons and $K^0$ mesons in the c.m.s., and also of $\pi$-mesons involved in the production of the $\Lambda$ and $K^0$ particles, are presented. The experimental distributions are compared with those computed by the statistical theory and single-meson diagrams. The angular and momentum distributions of particles accompanying the production of $\Lambda K^0$ and $K^0\bar{K}^0$ pairs are compared with those of particles created in $\pi^-$p interactions at 7 Bev without strange particle production. It is concluded that $\pi^-$p interactions involving the creation of $\Lambda K^0$ and $K^0\bar{K}^0$ pairs are more central than the $\pi^-$p interaction with the usual type of multiple pion production. Two types of $\pi^-$p interaction with strange particle production are established, which are nominally called "central" and "peripheral." (auth)

**19171** TOTAL CROSS SECTIONS FOR THE $\pi^-$p-REACTIONS AT 276 Mev. T. D. Blokhintseva, V. G. Grebinnik, V. A. Zhukov, G. Libman, L. L. Nemenov, G. I. Selivanov, and Yung-fang Yuan (Joint Inst. for Nuclear Research, Dubna, USSR). Zh. Eksperim. i Teor. Fiz., 44: 498-9(Feb. 1963). (In Russian)

The total cross sections for the $\pi^- + p \rightarrow \pi^- + \pi^+ + n$ and $\pi^- + p \rightarrow \pi^- + \pi^0 + p$ reactions at (276 + 10) Mev are measured with a liquid by hydrogen bubble chamber in a magnetic field. The experimental data are compared with theoretical predictions. (auth)

**19172** QUANTUM STATISTICAL THEORY OF MAGNETIC RESONANCE IN SYSTEMS WITH STRONG EXCHANGE INTERACTION. O. A. Olkhov and B. N. Provotorov (Inst. of Chemical Physics, Academy of Sciences, USSR). Zh. Eksperim. i Teor. Fiz., 44: 514-21(Feb. 1963). (In English)

From the quantum equation for the density matrix, equations are derived that characterize the behavior of magnetization of a system with strong exchange interaction in the high temperature region ($T \gg T_K$, where $T_K$ is the Curie temperature). These equations differ from phenomenological equations derived by some additional terms, which take into account the variation of the mean exchange interaction energy during saturation. It is shown that in accordance with the experimental data the shape of the resonance absorption line is of the Lorentz type and that its width at saturation weakly depends on the temperature. The equations predict a shift of the center of the absorption line and change of its width upon variation of a constant magnetic field. In consequence of the condition $T \gg T_K$ the equations proposed can be employed only for describing magnetic resonance in systems with a low Curie temperature (crystal free radicals, some ferrites and antiferromagnetic substances, etc.). (auth)

**19173** AMPLITUDE DISTRIBUTION OF BURSTS PRODUCED BY HIGH-ENERGY $\mu$ MESONS UNDER THICK FILTERS. O. V. Vedeneev (Vedenyeev), V. A. Dmitriev, and G. B. Khristiansen (Moscow State Univ.). Zh. Eksperim. i Teor. Fiz., 44: 556-60(Feb. 1963). (In Russian)

The trial and error method is employed for calculating the amplitude distribution of bursts produced by a monoenergetic flux of high-energy ($10^{13}$ and $10^{14}$ ev) $\mu$ mesons under thick lead filters. Creation of bursts as a result of direction production of electron-positron pairs by the $\mu$ mesons and $\mu$-meson bremsstrahlung is taken into account. The calculated burst distribution obtained is very broad. The possibility of determining the $\mu$-meson energy on the basis of the large and small bursts created by them under thick filters is discussed. (auth)

**19174** ON THE CLASSIFICATION OF ELEMENTARY PARTICLES. D. D. Ivanenko and D. F. Kurdgelaidze (Moscow State Univ.). Zh. Eksperim. i Teor. Fiz., 44: 587-91(Feb. 1963). (In Russian)

An attempt is made to classify elementary particles on the basis of nonlinear field theory and to derive the mass spectrum of baryons, mesons, and "resonons." (auth)

**19175** THEORY OF SECOND ORDER EQUATIONS FOR FERMIONS. V. S. Vanyashin (Dnepropetrovsk State Univ., USSR). Zh. Eksperim. i Teor. Fiz., 44: 603-9(Feb. 1963). (In Russian)

It is suggested that within the framework of second-order equation theory for fermions a universal connection between chirality and electric charge exists. More precisely, the components of any spinor field with positive chirality are always electrically charged and are subject to an electromagnetic gauge transformation whereas the components with a negative chirality are always electrically neutral. The universal weak interaction is of the type that changes the chirality, this being reflected in its axial vector structure as well as in the charge of the weak currents. The form of the Lagrangian for interaction with a pseudoscalar field is also considered for this theory. (auth)

**19176** PRODUCTION OF $\pi^-$ AND K-MESONS IN PROCESSES INVOLVING HIGH-ENERGY NEUTRINOS. Nguyen Van Hieu (Joint Inst. for Nuclear Research, Dubna, USSR). Zh. Eksperim. i Teor. Fiz., 44: 626-7(Feb. 1963). (In Russian)

The cross sections for multiple production of $\pi$ and K mesons by high-energy neutrinos are estimated. The possibility of experimental investigation of the structure of the vector current in weak interactions is considered. (auth)

**19177** APPLICATION OF THE DISPERSION RELATIONS TO THE COMPTON EFFECT ON THE PROTON. V. K. Fedyanin (Univ. of United Nations, USSR). Zh. Eksperim. i Teor. Fiz., 44: 633-48(Feb. 1963). (In Russian)

The Compton effect on the proton is analyzed with help of six dispersion relations for a fixed momentum transfer. The unitarity conditions in the single meson approximation permit the imaginary part of the amplitude to be expressed in terms of the coefficients in the angular distribution of the photoproduction processes $\gamma + p \rightarrow p + \pi^0$ and $\gamma + p \rightarrow n + \pi^+$[6]. By applying six exact (in the $e_0^2$-approximation) dispersion relations, nucleon "recoil" terms linear with respect to frequency in the dispersion integrals can be taken into account. This analysis leads to agreement with the experiments in the subthreshold and superthreshold regions, and yields an accurate value of the electric and magnetic polarizability of the proton. A number of characteristics of the process (phases, angular distributions, etc.) are computed for $0 < k_\Lambda < 800$ Mev. (auth)

**19178** REGGE POLES AND ASYMPTOTIC BEHAVIOUR OF AMPLITUDE IN PERTURBATION THEORY. Ya. I. Azimov and A. A. Anselm (Ioffe Inst. of Physics and Tech., Leningrad). Zh. Eksperim. i Teor. Fiz., 44: 686-94(Feb. 1963). (In Russian)

The correspondence between the asymptotic behavior of the amplitude with respect to momentum transfer in the lower approximations of perturbation theory and the position of the Regge poles is established for the case of scattering by a Yukawa potential. The consistency of perturbation theory with the presence of only moving poles can be verified in the higher approximations. The method developed is applied for investigation of relativistic field theory. It is found that the simple picture analogous to potential scattering does not agree with this result in perturbation theory. As a possible solution of the problem it is suggested that poles accumulate near integral negative points (and possibly near zero) because of the existence of many channels in field theory. (auth)

**19179** RESTRICTIONS IMPOSED ON THE REGGE TRAJECTORY BY MAXIMAL ANALYTICITY. I. A. Akhiezer (Inst. of Physics and Tech., Academy of Sciences, Ukrainian SSR). Zh. Eksperim. i Teor. Fiz., 44: 697-702 (Feb. 1963). (In Russian)

Restrictions imposed on the possible course of the trajectory of Regge poles a(t) by the analytical properties of the functions a are ascertained. It is assumed that functions a possess "maximal analyticity." Inequalities the functions obey for values of t below the threshold are established. Restrictions following from these inequalities on the masses of particles belonging to a given trajectory, and on the decrease of the cross sections with growth of the scattering angle at high energies (and in particular on the structure of the "diffraction peak," are determined. (auth)

**19180** THE INTERACTION AND THE HYPOTHETICAL STRUCTURE OF MUONS. A. I. Nikishov and I. L. Rozental'. p.48-71 of "Nekotoryye Voprosy Fiziki Elementarnykh Chastits i Atomnogo Yadra." Moscow, Gosatomizdat, 1962.

Papers published since 1939 on the interaction of muons and on hypotheses as to muon structure are reviewed. Muons have spin ½. The first radiative correction to the magnetic moment is consistent with experimental data. Accelerator experiments showed no scattering anomalies greater than $10^{-29}$ cm$^2$ per nucleon in the transfer of momenta less than 400 Mev. Muons can be described by Dirac's equation. It is still unknown why muons and electrons have different masses. The production of muons at very high energies ($\sim 10^{16}$ ev) should be studied and the following experiments are recommended: more precise measurement of the magnetic moment, investigation into the production of muon pairs with transfer of large momenta, determination of the form factors of protons and muons from $\mu$p scattering, experiments with oppositely directed beams of electrons and positrons, scattering of muons from electrons with transfer of a large transverse momentum, investigation of secondary-particle interaction ranges in nuclear collisions with $E_0 \gtrsim 10^{15}$ ev, search for anomalously scattered muons having an energy of more than 1 Bev and a cross section of $10^{-31}$ cm$^2$ per nucleon, and underground precision measurements of bursts in ionization chambers at great depths. (OTS)

**19181** NEUTRAL K-MESONS. I. Yu. Kobzarev. p.175-85 of "Voprosy Teorii Sil'nykh i Slabykh Vzaimodeystvii Elementarnykh Chastits." V. B. Berestetskii, ed. Erevan, Izd. Akad. Nauk Arm. SSR, 1962.

The properties and behavior of K mesons are discussed in connection with the problem of classifying elementary particles. If elementary particles are divided into two classes, according to whether or not the particles and antiparticles are identical, then K mesons lie on the dividing line and belong to neither class. The decay of $K^0$ mesons into pions and possible ways of determining the strangeness and parity of $K^0$ mesons are discussed from this point of view. The lifetime of $K_1^0$, which can decay into two pions, was obtained as $\sim 10^{-10}$ sec; that of $K_2^0$, which can only decay into three pions or leptons, was obtained as $\sim 5 \times 10^{-8}$ sec. The two $K^0$ mesons have different masses, the mass difference being $\Delta m$, but it is impossible to say theoretically which of them is the heavier. As the probability of finding $K^0 - (\overline{K}^0)$ is equal to $1 + (-)\cos\Delta mt/2$, and as the existence of a mass difference is responsible for the transition $K^0 \rightarrow \overline{K}^0$, $\Delta m$ plays the part of a transition amplitude; t is the time of flight in the $K^0$ rest system: $t = x\sqrt{1-v^2}/v$, or $t = x/v$ in the laboratory system. The possibility of measuring the absolute value of $\Delta m$ in $K^0 - \overline{K}^0$ interference effects is discussed theoretically, and some relevant experiments, such as those made by Cameroni and Piccioni, are examined in detail. (OTS)

**19182** THE SIGN OF THE MASS DIFFERENCE OF $K_1^0$ AND $K_2^0$-MESONS. S. G. Matinyan. p.186-90 of "Voprosy Teorii Sil'nykh i Slabykh Vzaimodeystvii Elementarnykh Chastits." V. B. Berestetskii, ed. Erevan, Izd. Nauk Arm. SSR, 1962.

The possibility of measuring the absolute value of the mass difference between the two $K^0$-mesons was previously shown but there were no experiments to decide the sign of $\Delta m$. To do this, it is necessary to determine the interference terms containing odd functions of $\Delta m$. One suggestion as to how to determine the sign of $\Delta m$ was previously made by Kobzarev and Okun'. It is based on investigating the passage of a $K^0$ wave through two thin plates, x = vt apart, where v is the velocity of the $K_2^0$-meson. Another possibility, requiring only one plate, is suggested. It is based on observing the decay modes $K^0 \rightarrow e^+ + \pi^- + \nu$ and $\overline{K}^0 \rightarrow e^- + \pi^+ + \overline{\nu}$ in the beam passing undeflected through a plate of thickness x. The number of these decays is equal to $N \pm \sim \frac{1}{2} \pm xr \exp(-t/2\tau_1) \cdot \sin(\varphi - \Delta mt)$; $\pm$ refers to $e^\pm$; t is the time-of-flight from the plate to the point of decay, and $\tan\varphi = \mathrm{Im}\,[f(0) - \overline{f}(0)]/\mathrm{Re}\,[f(0) - \overline{f}(0)]$, where f(0) and $\overline{f}(0)$ are the zero-angle elastic scattering amplitudes of $K^0$ and $\overline{K}^0$. It is easier to determine the sign of $\varphi$ than that of $\Delta\varphi$ in the experiment using two plates. From elastic scattering data, $\varphi$ can be estimated as $\approx +30^0$. The effect can be considerably magnified by increasing the oscillation amplitude and, as in the experiment using two plates, by choosing plates of optimum thickness. The sign of $\Delta m$ can be determined from that of $R = (N_+ - N_-)/(N_+ + N_-)$. Such an experiment using one thick plate is technically possible. (OTS)

**19183** NEKOTORYE VOPROSY FIZIKI ELEMENTARNYKH CHASTITS I ATOMNOGO YADRA. (Problems of Elementary Particle and Nuclear Physics). V. D. Mikhailov and I. L. Rozental, eds. Moscow, Gosatomizdat, 1962. 136p.

Ten articles are presented on elementary particle and nuclear physics. Separate abstracts have been prepared for nine articles. One article was abstracted previously in NSA. (R.V.J.)

**19184** INTERACTIONS OF $\mu$-MESONS AND THEIR PROBABLE STRUCTURE. A. I. Nikishov and I. L. Rozental. p.48-71 of "Nekotorye Voprosy Fiziki Elementarnykh Chastits i Atomnogo Yadra." Moscow, Gosatomizdat, 1962.

Interactions of $\mu$ mesons and their structure were studied, and it was shown that the $\mu$-meson spin is equal to $\frac{1}{2}$. The first radiative corrections for a magnetic moment agree with the experimental results. Scattering anomalies were not observed at $<10^{-29}$ cm$^2$/nucleon below 400 Mev. The experiments confirmed that the $\mu$ meson is described by the Dirac equation but differs from an electron by its mass value. (R.V.J.)

**19185** ELEMENTARY EVALUATION OF EFFECTS OF MEDIUM DENSITY ON BREMSSTRAHLUNG. I. I. Gurevich. p.72-6 of "Nekotorye Voprosy Fiziki Elementarnykh Chastits i Atomnogo Yadra." Moscow, Gosatomizdat, 1962.

Attehuation of bremsstrahlung by a medium and its multiple scattering polarization were evaluated. The medium and multiple scattering polarization reduce the coherent length value due to the increase of light phase rate and reduced rate of the electron longitudinal component. The analysis obtained a simple formula $\omega/E = q^2/1-q \cdot E/E^*$, where $q = \frac{1}{2}$ at $\omega = \frac{1}{2}E$ when $E = E^*$ ($\omega_\rho$ is the route of the equation $q_s(\omega) = q_\rho(\omega)$). (R.V.J.)

**19186** POSSIBILITY OF USING COSMIC RAYS FOR STUDYING $\mu$-MESON STRUCTURE. V. G. Kirillov-Ugryumov, A. A. Petrukhin, L. A. Prokhorova, and I. L. Rozental. p.77-82 of "Nekotorye Voprosy Fiziki Elementarnykh Chastits i Atomnogo Yadra." Moscow, Gosatomizdat, 1962.

High-energy particle scattering (under the condition that interactions are determined by electromagnetic forces) was studied in order to determine the character of electromagnetic interactions at a distance of about $10^{-13}$ cm. An analysis was made using a cosmic-ray $\mu$-meson source. (R.V.J.)

**19187** POLARIZATION OF POSITIVE $\mu^+$ MESONS IN COSMIC RAYS. B. A. Dolgoshein, B. I. Luchkov, and V. I. Ushakov. p.83-90 of "Nekotorye Voprosy Fiziki Elementarnykh Chastits i Atomnogo Yadra." Moscow, Gosatomizdat, 1962.

Polarization of a positive cosmic $\mu$ meson at 0.3, 1.05, and 1.55 Bev was measured at sea level, and 7798 $\mu \rightarrow e$ decays were recorded. The angular distributions of positrons were analyzed, and the $b \cdot \eta$ magnitude was estimated ($\eta$ is the polarization). The $b$ factor is a function of parameters for the experiment (the thickness, target material, and geometry) and the $\mu^+ \rightarrow e^+$ decay. Calculations for the asymmetry coefficient $b$ are included. (R.V.J.)

**19188** ON THERMODYNAMICS OF MULTIPLE PROCESSES. V. D. Mikhailov and I. L. Rozental. p.91-6 of "Nekotorye Voprosy Fiziki Elementarnykh Chastits i Atomnogo Yadra." Moscow, Gosatomizdat, 1962.

Statistical aspects of various multiple formation theories were used for developing equations for certain theories as a result of the general expression for multiple production probability. The covariant expression of production probability for N particles at high energies was considered as a general microcanonic distribution, and was used for developing expressions for all examined theories by means of thermodynamic relations, selecting for each theory a certain microcanonic distribution. Moreover, it is assumed that the multiplicity increases with energy and that the high losses permit a statistical approach. (R.V.J.)

**19189** ON THE PARTICIPATION OF NUCLEI IN INITIATING AND DEVELOPING ATMOSPHERIC SHOWERS. I. L. Rozental. p.97-106 of "Nekotorye Voprosy Fiziki Elementarnykh Chastits i Atomnogo Yadra." Moscow, Gosatomizdat, 1962.

An analysis was made of the possible relation between the wide shower fluctuations and variations in the character of collisions between cosmic nucleons and heavy atmospheric nuclei. (R.V.J.)

**19190** CHARGE EXCHANGE CROSS SECTION FOR SLOW MESONS ($\mu^+$) ON HYDROGEN ATOM. V. D. Mikhailov. p.107-17 of "Nekotorye Voprosy Fiziki Elementarnykh Chastits i Atomnogo Yadra." Moscow, Gosatomizdat, 1962.

The cross section of charge exchange in hydrogen was studied as a first step toward estimating the cross section of electron capture by a $\mu^+$ meson in an arbitrary substance. Calculations of scattering amplitudes and variable methods for calculating electron wave functions obtained for the total cross section $\sigma = \int d\sigma \cong 140\pi a_0^2$, indicating that the anticipated increase in capture probability was 100 fold higher than the orbital area. (R.V.J.)

**19191** ANNIHILATION OF ANTIPROTONS STOPPED IN HYDROGEN AND A HYPOTHESIS ON THE NEUTRAL $\rho$ MESON. V. I. Gol'danskii and V. M. Maksimenko. p.118-30 of "Nekotorye Voprosy Fiziki Elementarnykh Chastits i Atomnogo Yadra." Moscow, Gosatomizdat, 1962.

The existence of neutral $\rho^0$ mesons has been postulated, and several decay variations have been quoted in the published literature for the $\rho^0$ meson with 0 spin ($\rho_0^0$) – $\rho_0^0 \rightarrow \pi^+ + \pi + \gamma$, $\rho_0^0 \rightarrow 2\gamma$, and for $\rho_0^0$ meson with spin 1 ($\rho_1^0$) – $\rho_1^0 \rightarrow \pi^0 + \gamma \rightarrow 3\gamma$. The statistical theory of multiple processes was analyzed as a probable contribution to such decays (at variable $\rho^0$ meson mass) during the annihilation of antiprotons stopped in hydrogen. The available data deny the existence of a $\rho_0^0$ meson with less than 3.5 times the mass of the $\pi$ meson and $\rho_1^0$ meson with a mass less than 5.5 $m_\pi$. An attempt was made to reveal the $\rho^0$ meson on the basis of the "missing mass" spectrum (the spectrum of $M^* = \sqrt{E^2 - p^2}$, where $E$ is the total energy and $p$ is the total momentum for neutral annihilation products of antiprotons stopped in hydrogen). (R.V.J.)

**19192** ON THE PROBABILITIES OF USING BUBBLE CHAMBERS FOR STUDYING $K_2^0$ MESON DECAY PROPERTIES. A. M. Gal'per, L. A. Kuzin, and E. O. Okonov. p.131-5 of "Nekotorye Voprosy Fiziki Elementarnykh Chastits i Atomnogo Yadra." Moscow, Gosatomizdat, 1962.

The $K_2^0$ meson decay was studied using bubble chambers filled with argon, hydrogen, propane, freon 12 + freon 13 (50% + 50%), and xenon. The results indicated that the xenon-filled chamber has the highest recording rate for $K_2^0$ meson neutral decay products ($\pi^0$ and $\gamma$). However, the high xenon density complicates identification of $\pi \rightarrow \mu \rightarrow e$ decays. The bubble chamber with the freon mixture is quite efficient in recording $\pi^0$ mesons and $\gamma$ quanta and is capable of distinguishing $\pi$ and $\mu$ mesons. Thus, xenon and freon chambers have the best recording efficiency for $\pi^0$ mesons and $\gamma$ quanta. The problems encountered in recording $K_2^0 \rightarrow \pi^0 + \pi^+ + \pi^-$ and $K_1^0 \rightarrow 3\pi^0$ are resolved by $\gamma$ conversion from $\pi^0$ mesons and by determining the $\pi^\pm$ meson by the path in the liquid. A large bubble chamber in a neutral beam can be

used for recording new neutral long-life ($10^{-9}$ to $10^{-7}$ sec) particles. (R.V.J.)

**19193** ELASTIC AND INELASTIC SCATTERING OF MEDIUM ENERGY ELECTRONS IN A THIN $Al_2O_3$ TARGET. Werner Muschler. Thesis, Wurzburg, Ger., Universität, 1961. 36p. $2.00; 8 DM.

Elastic and inelastic scattering of 50 kev electrons in a thin $Al_2O_3$ foil is studied. The angular distribution of electrons with defined energy was measured with a magnetic spectrometer and an appropriate counting tube. Absorption free electron detection was possible down to 10 kev. The results of the measurements are in agreement with the quantum mechanical scattering theory. Corrections for the screening of the nucleons and for multiple scattering are discussed. The results of experiments with inelastic scattering are compared with theoretical predictions. The importance of multiple scattering and the influence of the binding between electrons and nucleons are discussed. (Gmelin Inst.)

**19194** EXPERIMENTAL AND THEORETICAL STUDIES OF PION-PROTON INTERACTIONS WITH ENERGIES OF 1 Bev. Ivan Derado. Thesis, Munich, Universität, 1961. 77p. $2.00; 8 DM.

The scattering of mesons($\pi^-$) by protons with a hydrogen bubble chamber is studied. The methods used for the analysis of the photographs are described in detail. Because the number of elastic meson($\pi^-$)-proton interactions that were analyzed was sufficiently high, the reliability of this method could be tested. The total and differential cross sections for the possible reactions were measured. Inelastic scattering is of special interest for this energy because the different reaction types can be differentiated experimentally. The possibility of describing the studied reaction theoretically is discussed. It is concluded that the statistical model gives only a crude picture but it can be useful until a better theory for higher energies is developed. (Gmelin Inst.)

**19195** BUBBLE CHAMBER EXPERIMENTS WITH RELATIVISTIC ELECTRONS STOPPED IN THICK TARGETS. Gert Harigel. Thesis, Wurzburg, Ger., Universität, 1961. 47p. $2.00; 8 DM.

The stopping of relativistic electrons with the same initial energy is characterized by the distribution of path lengths and penetration depths in the targets. Experiments were made with a 10-cm bubble chamber filled with propane or Freon using the electrons of the 35 Mev betatron of the University of Wurzburg, Germany. The experimental arrangement for the measurement of path lengths is described. The quotient of the path length divided by the penetration depths was determined, which is a measure for the scattering of the electrons. The results are compared with the theory of Blunck. (Gmelin Inst.)

## Neutron Physics

**19196** (CRRP-1140) ON NEUTRON DIFFUSION IN A PARALLEL-PLATE LATTICE. J. D. Stewart (Atomic Energy of Canada Ltd., Chalk River, Ont.). Feb. 1963. 24p. (AECL-1702)

Using diffusion theory to describe thermal neutron transport in a parallel-plate lattice and either diffusion theory or a step-function spatial slowing-down distribution for fast neutron transport, formulas are derived for the relaxation lengths for parallel and perpendicular diffusion and for the diffusion area under several definitions. Values of the reciprocal thermal diffusion length according to different definitions are compared; and several expressions for the thermal and fast leakage coefficients, derived by various methods, are presented. An expression for the migration area is derived, and the flux distribution corresponding to the spatial transient in two-group theory is examined. The conventional method is found to give reasonable values for the transient buckling but to yield considerable errors in the individual leakage coefficients. (D.C.W.)

**19197** (KAPL-M-RPC-3(Rev. 1)) FICS—A PROGRAM TO COMPUTE FEW-GROUP CONSTANTS WITHIN THE KARE DIFFUSION THEORY SYSTEM. Donald E. Goodman (Knolls Atomic Power Lab., Schenectady, N. Y.). Jan. 1963. Contract W-31-109-eng-52. 85p.

FICS is a group constant program available as an alternative to the WOXX routine within the KARE System. FICS computes diffusion constants and macroscopic cross sections for slowing down, absorption, $\nu$-fission, and total removal in two, three, or four energy groups for each compositional region in the reactor model. The one-group thermal constants are provided by a variational technique which computes an approximate Wigner-Wilkins flux spectrum as a linear combination of two trial spectra. These consist of a low-absorption spectrum and a high-absorption spectrum, covering the energies below 0.625 ev in 32 lethargy intervals. The thermal group constants are determined by averaging lethargy-dependent microscopic cross sections and diffusion constants over the composite spectrum. FICS' thermal constants are temperature-dependent with region temperatures from 68 to 600°F permitted. In the fast energy range, 10 Mev to 0.625 ev, the program computes temperature-independent constants in one, two, or three energy groups. These are determined from stored microscopic cross sections which were obtained by curve fitting to MUFT parameters over a wide range of metal-water ratios. FICS provides optional calculations, some of which modify the group constants for special purposes, while others merely prepare and transmit data to other segments. Included are: automatic Xenon determination; special prescriptions for thin, highly absorbing regions; an adjoint option; a technique for handling "window shade" control rods; automatic calculation of fission products; mixed number density modification; spectrum option; precalculated group constant option, depletion option; AMOK option; and special calculations for r-z synthesis. (auth)

**19198** (LA-2390(Suppl.)) SPACE, ENERGY AND TIME DISTRIBUTION OF NEUTRONS AT THE GROUND-AIR INTERFACE. Calculated by Monte Carlo Code NHM. Wendell A. Biggers and Margaret R. Hemmendinger (Los Alamos Scientific Lab., N. Mex.). Mar. 1962. Contract W-7405-eng-36. 114p.

Calculations are presented which were obtained from the NHM Monte Carlo Code. In one calculation, only the shock wave is varied. In another, both the shock wave and source height are altered. (auth)

**19199** (NAA-SR-7770) THERMAL NEUTRON TRANSMISSION THROUGH CADMIUM-COVERED FOILS. J. A. DeJuren and R. K. Paschall (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Mar. 15, 1963. Contract AT(11-1)-Gen-8. 12p.

The transmission of thermal neutrons through cadmium covers as a function of cadmium thickness was measured in a graphite stack at various heights above the thermal column of the AE-6 reactor. An aluminum disk containing slots for the foils was rotated in the center graphite

stringer position. Foils of 40% indium and 60% tin, 0.005 in. thick, were used as detecting foils and were beta-counted. As the thermal flux incident on a cadmium cover is depressed relative to the flux incident on a bare foil, a foil with a thick cadmium cover on one side only was used for the zero thickness measurement; and its activity was doubled. The resultant thermal activities as a function of cadmium thickness were consistent with the exponential integral $2E_3(\Sigma_a d)$, where $E_3(\tau) = \int_1^\infty (e^{-\tau x}/x^3)\,dx$, and a value of 2514 barns was used for the absorption cross section of cadmium. For $\tau = 0$, $2E_3(\tau) = 1$. (auth)

**19200** (NAA-SR-Memo-7940) DSDE—A COMPUTER PROGRAM FOR CALCULATION OF MULTIGROUP THERMAL SCATTERING CROSS SECTIONS. M. A. Boling and W. A. Rhoades (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Nov. 6, 1962. Contract [AT(11-1)-Gen-8]. 28p.

A computer program, DSDE, for calculating flux weighted multigroup scattering cross sections by numerical integration of a differential scattering kernel supplied as a Fortran function subprogram is described. The integration is performed by a Gaussian integration routine of proven high efficiency. Scattering cross sections are normalized and punched in format suitable for input to the ULCER library code. Addressable data input are used, so that successive problems can be specified with minimal effort. Four scattering kernel options, under external control, are provided. (auth)

**19201** (RISÖ-55) DESCRIPTION OF DC-2, A TWO-DIMENSIONAL, CYLINDRICAL GEOMETRY, TWO-GROUP DIFFUSION THEORY CODE FOR DASK, AND A DISCUSSION OF THE THEORY FOR SUCH CODES. G. K. Kristiansen (Denmark. Atomenergikommissionen. Forsøgsinstitut, Risø). Jan. 1963. 27p.

The DC-2 code is a two-dimensional, two-group, diffusion-theory code in cylindrical geometry for the Danish computer DASK. A description is given of the code and of some theoretical questions related to the convergence of such codes. In particular, the conjecture that the eigenvalues of the diffusion operator are always real and positive is shown to be false. However, it is shown that in some cases, for instance for most practical two-group models, the eigenvalues lie, indeed, in the vicinity of the positive part of the real axis. Both discrete and the continuous cases are discussed. (auth)

**19202** (TID-18284) TEMPEST II—A NEUTRON THERMALIZATION CODE. R. H. Shudde and J. Dyer (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). June 1962. 61p.

The TEMPEST II neutron thermalization code in Fortran for IBM 709 or 7090 calculates thermal neutron flux spectra based upon the Wigner-Wilkins equation, the Wilkins equation, or the Maxwellian distribution. When a neutron spectrum is obtained, TEMPEST II provides microscopic and macroscopic cross section averages over that spectrum. Equations used by the code and sample input and output data are given. (auth)

**19203** (TID-18428) ON THE ENERGY-DEPENDENT TRANSPORT EQUATION. G. C. Summerfield and P. F. Zweifel (Michigan. Univ., Ann Arbor). [1962]. Contract AT(11-1)-917. 5p.

Within the framework of the heavy-gas model of a neutron-moderating medium, the anisotropic contribution to the scattering is about on the order of (neutron mass/moderator mass)$^2$, so that energy-dependent neutron transport equations assuming isotropic scattering are reliable. (T.F.H.)

**19204** (TID-18429) SLOW NEUTRON SCATTERING, THE "SCATTERING LAW," AND $G(\underline{r},t)$. G. C. Summerfield and P. F. Zweifel (Michigan. Univ., Ann Arbor). [1962]. Contract AT(11-1)-917. 13p.

The general relations between the energy moments of the inelastic cross section for slow neutron scattering and the so-called "Placzek moments" are derived. These relations are used to clarify the apparent confusion that exists concerning the comparison of these quantities. Also, a new method of determining the "pair correlation function," $G(\underline{r},t)$, from slow neutron scattering experiments is described. This method should yield better results than direct Fourier transformation of the scattering data. However, existing experimental techniques are probably not sufficiently accurate to make this method completely practical at this time. (auth)

**19205** (TID-18432) NEUTRON THERMALIZATION IN SOLIDS (thesis). Kaye Don Lathrop (California Inst. of Tech., Pasadena). June 1962. 171p.

To describe neutron thermalization in solid media, two simplified models are formulated to describe the motions of atoms bound in solids. One atomic model postulates that the atoms of solids are linear, classical, randomly oriented, harmonic oscillators characterized by a single energy; and the other model postulates the same basic oscillator but permits a distribution of oscillator energies. With atom speed distributions derived from these models, energy exchange cross sections are evaluated analytically assuming a free particle neutron-atom interaction. With these energy exchange cross sections, integral equations are formulated describing thermalization of neutrons in infinite homogeneous media containing a 1/v absorber. The integral equations of both atomic models are solved numerically for the neutron density speed distribution. Numerical results for the single energy atomic oscillator of unit mass are compared with experimental results for neutron thermalization in zirconium hydride. Results for the averaged energy atomic oscillator of unit mass are compared with the neutron density calculated from the Wigner-Wilkins monatomic gas model. This comparison is made for three values of absorption. Numerical results for averaged energy atomic oscillators of masses 1, 2, 9, and 12 are examined to determine the effect of atomic mass upon the neutron density distribution. Computer programs used in solution of the thermalization equations are presented. 51 references. (auth)

**19206** (WAPD-T-1377) EPITHERMAL NEUTRON ABSORPTION IN SLAB LATTICES. M. Goldsmith (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). July 1962. Contract [AT(11-1)-Gen-14]. 17p.

A few-group method of calculating the epithermal flux in the vicinity of a slab absorber is developed. Non-moderating absorbers are treated in the P-1, P-3, and DP-1 approximations. An iterative method of including the effects of moderation in the slab is also discussed. (auth)

**19207** (WAPD-T-1524) EFFECT OF SOURCE ENERGY DEPENDENCE ON SPECTRUM HARDENING. W. W. Clendenin (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). July 1962. Contract AT(11-1)-Gen-14. 7p.

Comparisons are presented of neutron absorption cross sections calculated from the Nelkin model spectra for the isotopic compositions of the measured spectra of Beyster, Wood, Lopez, and Walt (Nucl. Sci. and Eng. 9: 168(1961)) and for various values of S(E), where this term represents the scattering-in of neutrons from energies above the upper energy limit of $E_0$ of the thermal group. (J.R.D.)

**19208** (WAPD-TM-363) PDQ-5—A FORTRAN PROGRAM FOR THE SOLUTION OF THE TWO-DIMENSIONAL NEUTRON-DIFFUSION PROBLEM. PART 1: STEADY-STATE VERSION. W. R. Cadwell (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). Feb. 1963. Contract AT(11-1)-Gen-14. 32p.

The steady-state version of a computer program (PDQ-5) for solving the few-group, time-independent, neutron-diffusion equations for a heterogeneous reactor is described. The Fortran program permits up to five lethargy groups with either one or two thermal groups and restricts the product of groups and solution points to 250,000. The solution is obtained over a nonuniform mesh imposed on a rectangular region of the r−z or x−y plane. (D.C.W.)

**19209** (WAPD-TM-364) NUMERICAL METHODS AND TECHNIQUES USED IN THE TWO-DIMENSIONAL NEUTRON-DIFFUSION PROGRAM PDQ-5. L. A. Hageman (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). Feb. 1963. Contract AT(11-1)-Gen-14). 86p.

A description is given of the mathematical theory and methods used in the PDQ-5 program to obtain the numerical solution to the few-group, time-independent, neutron diffusion equations in two dimensions. The finite difference approximations of the continuous problem for both x−y and r−z geometries and the properties of the resulting matrix problem are given. The mathematical features and the practical applications of the numerical methods used to solve the matrix problem are discussed in detail. 24 references. (auth)

**19210** DETERMINATION OF THE DIFFUSION LENGTH OF THERMAL NEUTRONS IN WATER AT TEMPERATURES BETWEEN 20 AND 50°C. N. Mateescu and V. Nahorniak (Institutul de Fizica Atomica, Bucharest). Acad. Rep. Populare Romine, Studii Cercetari Fiz., 13: 473-6 (1962). (In Rumanian)

The dependence of the diffusion length on the moderator, due to variations in the velocity distribution of the thermal neutron flux, the absolute velocity of the nuclei, and the density of the moderator, was investigated by determining the diffusion length at 20°, 39°, and 50°C in distilled water, using a stationary thermal neutron source. A 60-cm-high and 10-cm-diam. cylindrical container was placed in front of one of the horizontal beamholes of the reactor, covered with a suitable Pb shield to reduce the flux which was measured by the activation of an In foil. Parallel tests were run with a Cd shield in order to eliminate the effect of the epithermal neutrons. The slope of the temperature dependence line was found to be $\Delta L/\Delta T = (0.0041 \pm 0.0003)$ cm/°C, thus being quite close to the value reported by G. von Dardel and N. G. Sjörtendt (Phys. Rev., 96: 1245(1954)). (TTT)

**19211** NEUTRONIC FLUCTUATIONS IN A NUCLEAR REACTOR HAVING CELLULAR STRUCTURE. Austin Blaquière, René Castagné, and Jean Cazemajou (Université, Paris). J. Phys. Radium, 23: Suppl. No. 12, 193A-200A(Dec. 1962). (In French)

The method of noise-equivalent random excitation uses the analogies between the behavior of a reactor and that of certain common radio electric circuits. The fluctuations may then be calculated by introducing into the circuit a suitable noise source. This method was generalized and extended to the case of a reactor having a cellular structure, with delayed neutrons, and applied to fluctuations within a cell. It is thus shown that the fluctuations in a cell are the result of two terms: a rapidly evolving Poissonian noise, not related to the overall fluctuations; a slowly evolving noise, when the reactor is not too far from criticality, which is related to the overall fluctuations. The first term arises from rapid ordering of the system, during which time the cells come mutually into equilibrium. The second term is due to the coordinated evolution of all the cells, after the end of the first transitory phase. The method may also be applied to the case of an artificial random neutron source, electronically modulated. (auth)

**19212** THE DIRECT SOLUTION OF FIXED DIFFERENCE EQUATIONS IN THE DIFFUSION THEORY. C. Polze (VEB Entwicklung und Projektierung Kerntechnischer Anlagen, Berlin). Kernenergie, 5: 829-31(Dec. 1962). (In German)

A method for the direct solution of two-dimensional diffusion difference equations was explained. The algorithm was discussed with respect to its accumulator plate needs and the calculation time. It was tested on the ZRA-1 of the VEB Entwicklung und Projectierung Kerntechnischer Anlagen, Berlin. (tr-auth)

**19213** THERMAL NEUTRON SPECTRA IN THE TWO-REGION SYSTEM. Yorio Gotoh and Akira Furuhashi (Japan Atomic Energy Research Inst., Tokyo). Nippon Genshiryoku Gakkaishi, 5: 119-26(Feb. 1963). (In English)

The steady-state space-energy distribution of thermal neutrons in the two-region system was investigated in the diffusion approximation. The theory was free from the assumption that the neutron spectrum is a superposition of the infinite medium spectra of both regions. The neutron spectrum in each region is represented by the combination of several components, each having a definite spectrum and an associated diffusion length which are to be determined as an eigenmode and a corresponding eigenvalue respectively. Such expanded spectra in both regions are interconnected on the boundary so as to satisfy the physical conditions, and hence to determine the amplitude of each eigenmode. The formalism is a general one and the extension to the case of more than two regions is possible with due labors. Numerical results were obtained for a case of spherical two-region system using the heavy-gas model for the energy transfer kernel. (auth)

## Nuclear Properties and Reactions

*Refer also to abstracts 17638, 17640, 17641, 18376, 18530, 18534, and 18610.*

**19214** (AI-6699) TABLES AND GRAPHS FOR COMPUTING DEBYE-WALLER FACTORS IN MÖSSBAUER EFFECT STUDIES. Arthur H. Muir, Jr. (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Jan. 15, 1962. Contract [AT(11-1)-Gen-8]. 14p.

A table of functions is presented that simplifies the evaluation of the Debye-Waller factor which gives the fraction of recoil-free gamma ray processes in Mössbauer effect studies. A graph of the recoil-free fraction, f, as a function of the ratio of the Debye temperature to the crystal temperature for selected recoil energy to Debye temperature ratios is included for rapid estimation of f. (auth)

**19215** (ANL-6662) COMPUTER PROGRAM FOR CALCULATING THE RELATIVE YIELDS OF ISOMERS PRODUCED IN NUCLEAR REACTIONS. W. L. Hafner, Jr., J. R. Huizenga, and R. Vandenbosch (Argonne National Lab., Ill.). Dec. 1962. Contract W-31-109-eng-38. 61p.

A three-part Fortran program for IBM 704 computation of the relative cross sections of isomers produced in nuclear reactions is described. The three subprograms compute the partial compound nucleus cross sections and the

normalized initial compound nucleus spin distribution, the normalized spin distribution following particle emission, and the normalized spin distribution following gamma emission. The Fortran listing of the program and cards for a sample problem is included. (D.C.W.)

**19216** (IS-494) RELATIONSHIPS BETWEEN STATES OF NUCLEI WITH CONSTANT NEUTRON EXCESS. F. Everling (Ames Lab., Ames, Iowa). [July 11, 1962]. Contract W-7405-Eng-82. 46p.

Level schemes of light nuclei with constant neutron excess are correlated by means of the nuclidic mass excess to show that the $1d_{\frac{5}{2}}$ subshell has an almost linear trend in the mass excess or total nuclear binding energy of excited states and ground states as a function of the mass number. The systematics suggests a $Ne^{20}$ 0.65 Mev, $0^+$ level for which only weak experimental evidence exists. This state would form a linear relation with the ground states of $Mg^{24}$ and $Si^{28}$, analogous to established linear trends for the first $2^+$ and $4^+$ states of these 3 nuclei. The $O^{16}$ 6.052 Mev, $0^+$ state appears to be the beginning of this trend, where the $1d_{\frac{5}{2}}$ subshell is empty, but with a rearranged $O^{16}$ ground state. The rearrangement energy seems to be independent of additional $2s_{\frac{1}{2}}$ nucleons. (auth)

**19217** (LADC-5297) DIRECT REACTIONS LEADING TO LOW STATES OF $Be^8$. H. E. Wegner, W. S. Hall (Los Alamos Scientific Lab., N. Mex.), and D. W. Miller (Indiana. Univ., Bloomington). [nd]. Contract [W-7405-eng-36]. 8p.

Ground and first excited states of $Be^8$ were excited by one- and two-particle stripping processes with the $Li^6(He^3,p)$, $Li(He^4,d)$, $Li^7(He^3,d)$, and $Li^7(He^4,t)$ reactions to study direct interaction mechanisms. $He^3$ and $\alpha$ particles were also elastically scattered from $Li^6$ and $Li^7$ to provide data for an independent determination of optical model parameters describing the initial reactions channels. Parameters obtained by fitting the four elastic angular distributions with an optical model code provided a good qualitative fit to the $Li^7(He^3,d)$ ground-state reaction. An attempt at fitting the $Li^7(He^4,t)$ reaction did not show proper qualitative behavior of the angular distributions. (D.C.W.)

**19218** (LADC-5391) EXPERIMENTAL STUDY OF THE $Mg^{26}(He^3,\alpha)Mg^{25}$ REACTION. A. G. Blair and H. E. Wegner (Los Alamos Scientific Lab., N. Mex.). [1962]. Contract [W-7405-eng-36]. 8p.

The $(He^3,\alpha)$ reaction at about 15 to 25 Mev takes place preferentially through channels requiring large changes in angular momentum ($l$). The presence of admixtures of high-$l$ particle configurations in $Mg^{26}$ is therefore studied by means of the reaction $Mg^{26}(He^3,\alpha)Mg^{25}$ at a $He^3$ energy of 20 Mev. It is found that levels in $Mg^{25}$ requiring changes in $l$ of 2 and 4 are excited much more strongly than levels requiring a change in $l$ of 0. (T.F.H.)

**19219** (NIRL/R/22) SOME PROGRAMMES FOR GEOMETRY CALCULATIONS IN SCATTERING EXPERIMENTS. R. S. Gilmore and C. J. Batty (Gt. Brit. National Inst. for Research in Nuclear Science. Rutherford High Energy Lab., Chilton, Berks, England). Dec. 1962. 31p.

Some Mercury Autocode computer programs which deal with geometrical problems involved in scattering a particle beam of finite size from a flat target into detectors of finite area are described. (auth)

**19220** (PNE-114F) SYMMETRY OF NEUTRON-INDUCED $U^{235}$ FISSION AT INDIVIDUAL RESONANCES. G. A. Cowan, B. P. Bayhurst, and R. J. Prestwood (Los Alamos Scientific Lab., N. Mex.). Feb. 1963. Project 7.03 of PROJECT GNOME. 18p.

Neutrons from the Project Gnome nuclear test are resolved in energy by time-of-flight and used to study symmetry of fission in $U^{235}$ in the resonance region. Symmetry is deduced by measurement of the fission product ratio $Ag^{111}/Mo^{99}$ at resonances from 8.8 to 40 ev. The maximum decrease observed in the probability of symmetric fission (as compared to the probability in thermal-neutron fission of $U^{235}$) is 50%. The maximum increase observed is 22%. Four levels show an increase, and 13 levels show a decrease, in symmetry. (auth)

**19221** (PUC-1963-95) STUDIES OF RADIOACTIVE DECAY IN THE REGION OF DEFORMED NUCLEI (thesis). Joseph M. Prospero (Princeton Univ., N. J. Frick Chemical Lab. and Princeton Univ., N. J. Palmer Physical Lab.). Feb. 1963. Contract AT(30-1)-937. 220p.

The recovery of radio-platinum from iridium cyclotron targets is investigated; methods are presented for the dissolution of the targets and for the extraction of platinum as the platinum-tin complex into ethyl acetate. The separation of platinum from tin is investigated, making use of tracers, and a method employing Dowex 50 cation exchange resin is presented. A procedure for the separation of sub-milligram quantities of platinum and iridium using Dowex 1 anion exchanger is described. The decay of the platinum-188 mass-chain is investigated. The decay scheme of iridium-188 is determined by means of gamma-ray, conversion-electron and gamma-gamma coincidence spectroscopy; the decay scheme presented differs considerably from those previously published. The existence of the first-rotational (3+) member of the gamma vibrational (K = 2) state in osmium-188 is established through the use of high-resolution conversion-electron spectroscopy. The ratios of the reduced transition probabilities for the interband transitions are not consistent with an assignment of pure K = 2 to the upper band; these differences are attributed to the mixing of the K = 0 and the K = 2 bands with a coupling strength parameter of z = 0.12. The decay of the platinum-189 mass chain is examined. A decay scheme is presented for levels in iridium-189. Several intrinsic levels, some with well-developed rotational bands, are identified; the rotational bands give evidence of rotation-vibration interaction. The half-life of iridium-189 is measured and found to be 13.3 ± 0.1 days. The decay of the 30.8 kev isomeric state in osmium-189 is investigated and is found to have a half-life of 6.0 ± 0.1 hours. The 30.8 kev M3 transition to the ground state is very highly converted in the LIII shell; as a result, only the x-rays from electron transitions to the LIII shell vacancies are observed in the L x-ray spectrum. An x-ray spectrum showing these effects has not been previously reported. The decay of terbium-158 to levels in gadolinium and dysprosium-158 is investigated; the latter two nuclides are found to adhere to the strong-coupling model. The presence of a negative parity (3-) state at 1040 kev in gadolinium-158 is indicated. The strong feeding of the high-spin states in gadolinium-158 leads to the assignment of a spin of 3- to the ground state of terbium-158. Calculations yield a half-life of 150 ± 30 years for terbium-158. 83 references. (auth)

**19222** (TID-16603) THE NEUTRON STRENGTH FUNCTION AND THE SHELL MODEL. Barry Block and Herman Feshbach (Massachusetts Inst. of Tech., Cambridge. Lab. for Nuclear Science). [Sept. 13, 1962]. Contract AT(30-1)-2098. 38p.

The projection operator-equivalent potential method is employed for the study of neutron widths and the neutron strength function. Assuming that the residual potential can

be written as a sum of two-particle potentials, it can be shown with the aid of another plausible assumption that the width can be written as a product of two factors. One of these is the square of the matrix element of $V_R$ between the open-channel wave function and a "shell model" two-particle-one-hole state. This factor measures the probability that in the first scattering of the incident particle a transition to the two-particle-one-hole state occurs. The factor contains the fluctuations in the width that accompany changes in the target nucleus. The second factor, giving the probability that the stationary-state counterpart of the compound nucleus wave function contains the two particle-one hole state, has a Lorentzian form that describes the decrease of this probability as the difference between the resonance energy and the energy of the two-particle-one-hole state increases. The results are generalized to include the case where the energies of several two-particle-one-hole states fall close to each other. Here it is found that the giant resonance for the widths will now have a sub-structure that should be observable. The strength function is found to depend upon the average of the transition probabilities to the two particle-one hole states, the number of these states, and their width $\Delta$. The number is sharply limited by the requirements that angular momentum and spin be conserved in the transition and that energy be conserved, within an error equal to $\Delta$. If the residual potential is expanded in multipoles, keeping terms up to and including the quadripole, it is found that in the region $40 \leq A \leq 70$ the only possible transitions involve the monopole; that between A = 70 and 85 both dipole and quadripole terms are effective; and that between 85 and 130 only the quadripole term can induce transitions. This behavior enables a fit to the data to be obtained by means of three parameters, viz., the average matrix elements squared for the monopole, dipole, and quadripole parts of the residual potential. The resulting fit demonstrates the essential importance of the first transition that the incident particle undergoes. (auth)

**19223** (TID-16621) NUCLEAR LEVELS OF $F^{20}$. Carl T. Hibdon (Argonne National Lab., Ill.). June 1962. Contract [W-31-109-Eng-38]. 43p. (UAC-6570)

The nuclear levels of $F^{20}$ are investigated at neutron energies from about 1 to 300 kev. Only a few resonances can be attributed to s-wave levels. Remaining resonances that can be analyzed are attributable to p-wave levels. The two resonances near 27 and 49 kev are investigated extensively and can be attributed to p-wave levels. However, the assumption of mutual interference between this pair of levels is ruled out, because their spins of 2 and 1 respectively appear to be well determined, and each resonance exhibits an asymmetrical shape that is just the reverse of what it should be for mutual interference. The cluster of resonances near 100 kev consists of three p-wave levels (one each with J = 0, 1, and 2) and a fourth resonance attributable to an s-wave level. Two other small peaks occur on the high-energy side of the cluster. For the levels that can be analyzed, the s-wave strength function is found to be small and the p-wave one very large. (auth)

**19224** (TID-16627) HALF-LIFE OF $Kr^{85}$. J. Lerner (Argonne National Lab., Ill.). June 1962. Contract [W-31-109-eng-38]. 21p. (UAC-6514)

The half life of $Kr^{85}$ is measured as 10.76 yr, by direct measurement of the decay of the 0.7-Mev beta activity over a period of 10 yr. (T.F.H.)

**19225** (TID-16638) SEARCH FOR DELAYED NEUTRON EMISSION IN $Br^{86}$ DECAY. Ellis P. Steinberg and Larry L. Schwartz (Argonne National Lab., Ill.). June 1962. Contract W-31-109-Eng-38. 10p. (UAC-6574)

A search for delayed neutron activity in the decay of 54-sec $Br^{86}$ is carried out. No significant activity is observed, but an upper limit for the neutron branch of 0.11% is set. This limit corresponds to a maximum of 5% for the possible contribution of $Br^{86}$ to the 55-sec delayed neutron period, observed in the thermal neutron fission of $U^{235}$ and ascribed to $Br^{87}$. (auth)

**19226** (TID-16648) ISOMER RATIOS FOR $Y^{87,87m}$ AND THE SPIN DEPENDENCE OF THE NUCLEAR LEVEL DENSITY. R. Vandenbosch (Argonne National Lab., Ill. and Copenhagen. Universitet. Institut for Teoretisk Fysik) and L. Haskin (Argonne National Lab., Ill. and Wisconsin. Univ. Madison). June 1962. Contract [W-31-109-eng-38]. 33p. (UAC-6512)

Isomeric cross section ratios were measured for the following nuclear reactions in which the $Y^{87,87m}$ isomeric pair is produced: $Rb^{85}(\alpha,2n)$, $Sr^{86}(d,n)$, $Sr^{87}(d,2n)$, and $Sr^{88}(d,3n)$. The results are interpreted in terms of the angular momentum dependence of the nuclear level density. Statistical model calculations based on a simple Fermi gas model and on a modified Fermi gas model that includes a simple form of pairing interaction were performed. Ambiguities in the calculation related to level density parameters and the multipolarity of the emitted radiation are discussed. Comparison of the results of the calculations with experiment indicates the importance of the pairing interaction, but does not necessarily support the particular pairing model chosen. 36 references. (auth)

**19227** (TID-18340) CONTINUOUS REPRESENTATIONS IN THE STATISTICAL THEORY OF ELECTRONIC ENERGIES. Sidney Golden (Brandeis Univ., Waltham, Mass.) and George S. Handler (Tufts Coll., Medford, Mass.). [1961]. Contract [AT(30-1)-1355]. 25p.

A generalized Thomas-Fermi single particle theory is constructed. Application to multiparticle systems is achieved by invoking the idea of the self-consistent field. There appears to be one glaring deficiency in the Thomas-Fermi theory: the density of electrons is either singular in the vicinity of a nucleus or is set equal to zero. Efforts to resolve this deficiency are discussed. Equations for the approximation of electronic energy using the statistical theory of continuous representations are presented. Improvement in energies found may be carried over into a self-consistent field calculation. A series of such calculations is in progress. A molecular system of high symmetry is suitable for treatment in this manner. (H.G.G.)

**19228** (TID-18424) THE VALIDITY OF THE FERMI APPROXIMATION IN SLOW NEUTRON SCATTERING. J. P. Plummer and G. C. Summerfield (Michigan. Univ., Ann Arbor). [1962]. Contract AT(11-1)-917. 8p.

The correction to the Fermi approximation for the cross section is calculated for slow neutron scattering from a proton bound in a harmonic potential. For neutron energies up to fifteen times thermal energy, and for energy transfer due to proton transitions between the ground state and first excited state, the Fermi approximation is found to be accurate to 0.5%. Previous calculations for $d\sigma/d\Omega$ that considered only elastic scattering from the proton initially in the ground state are thereby extended. (auth)

**19229** (TID-18444) A STUDY OF PROTON-INDUCED SPALLATION REACTIONS OF NEODYMIUM-150. Progress Report, June 1, 1962–May 31, 1963. Clarence G. Heininger, Jr. (Saint John's Univ., Brooklyn). Contract AT(30-1)-2545. 4p.

The status of the attempt to determine the cross sections for the production of $Ce^{143}$ and $Pr^{143}$ in the proton spallation of $Nd^{150}$ is reported. Cross sections for the proton spallation of several other targets were measured. Application of evaporation theory to the end of the neutron and proton cascade-evaporation chains that lead to the product nuclides gave fair qualitative, but not quantitative, agreement with the available isobaric yield ratios for (p, 2p6n) and (p, 3p5n) reactions. A technique for the clean, rapid separation of rare earths with a high speed chromatograph was developed. (D.C.W.)

**19230** (WAPD-T-1506) MEASUREMENTS OF THE URANIUM METAL AND URANIUM OXIDE TEMPERATURE COEFFICIENT OF RESONANCE ABSORPTION. B. L. Palowitch and F. S. Frantz, Jr. (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). Apr. 1962. Contract AT(11-1)-Gen-14. 33p.

The relative effective resonance integral of $U^{238}$ was measured as a function of temperature for uranium and $UO_2$ cylinders, 0.986 and 0.973 cm diameter, respectively. The Doppler coefficients of resonance absorption $\alpha$ and $\beta$ were determined. The measurements utilized the activation technique in which the induced $Np^{239}$ activity of a uranium bearing specimen was determined as a function of specimen temperature during irradiation. Measured values for $\alpha$ and $\beta$ corrected for thermal expansion, 1/v absorption and fission activity, normalized to a 1/E epithermal flux are given as well as the average experimental temperature range $(t-t_0)$ for which the results were obtained. The results are considered to be consistent with the results of other experiments in which the activation technique was used but are lower than theoretical predictions given by Nordheim and Rosen. 20 references. (auth)

**19231** (AEC-tr-5702) BINDING ENERGY AND SINGLE-PARTICLE MODEL OF THE ATOMIC NUCLEI. K. Woeste. Translated by Lydia Venters (Argonne National Lab., Ill.) from Z. Physik, 137: 228-(1954). 11p.

The binding energies of atomic nuclei in a single-particle model are shown to be subject to quantitative description. Within the framework of this model, it was found that nuclei may exist only in one of the closely-surrounding Gamow-Bach regions. Outside this region, the number of nucleons is larger than the number of present levels at the single-particle potential related to this nucleon number. The effect on the term density of nuclear spectra is discussed. (auth)

**19232** DETERMINATION OF THE TOTAL CROSS SECTION OF LEAD IN THE COLD NEUTRON RANGE. H. Teutsch, N. Mateescu, and P. Timis (Institutul de Fizica Atomica, Bucharest). Acad. Rep. Populare Romine, Studii Cercetari Fiz., 13: 477-8(1962). (In English)

The time-of-flight method was used for measuring the total cross section of Pb in the cold neutron range, carrying out the determination at the horizontal beamhole of the reactor covered with a Pb shield which had an identical composition with the specimen under study. The distance of the flight was 3 m while the chopper had curved slots; angular speeds of 4350 and 2830 rpm were used for measurements in the 2.6 to 7.5 Å and 5.2 to 10.1 Å regions, respectively. Parallel daily measurements have been made with and without Cd shield, attempting to minimize the statistical error. The values obtained were somewhat higher than those reported by J. Highes and B. Schwartz (BNL-325, 1958); this is probably due to the effect of impurities in the Pb specimen used. (TTT)

**19233** ON THE TRANSFER OF CHARGED PARTICLES IN REACTIONS WITH HEAVY IONS. V. K. Lukyanov (Joint Inst. for Nuclear Research, Dubna, USSR). Acta Phys. Polon., 22: 529-31(Dec. 1962). (In English)

Peripheral collisions of heavy ions with the transfer of charged particles, p and $\alpha$, to the bound state of the final nucleus are investigated. The motion of ions is assumed to be a quasiclassical one. The reaction with the transfer of an $\alpha$ particle from $C^{12}$ to the target nucleus with mass $M \gg Mc^{12}$ is considered. (C.E.S.)

**19234** DIFFRACTION SCATTERING OF DEUTERONS ON NON-SPHERICAL NUCLEI. II. DEFORMATION OF ARBITRARY MULTIPOLARITY. J. Borysowicz and J. Dąbrowski (Univ. of Warsaw and Inst. for Nuclear Research, Polish Academy of Sciences, Warsaw). Acta Phys. Polon., 22: Suppl., 35-43(1962). (In English)

The Drozdov-Blair diffraction scattering model is extended to the case of deuteron scattering on nuclei with surface deformation of an arbitrary multipole order. The structure of the deuteron is taken into account by applying the Achiezer-Sitenko method. Both the universal curve rule and the phase relation of Blair remain approximately valid. The differential cross sections obtained are similar to those obtained with the simple Drozdov-Blair model, provided one diminishes the black nucleus radius $R_0$ by approximately one-fourth of the deuteron radius $R_d$, and increases the deformation parameter $|\beta_1|$ approximately by the factor $(1 + 3\,R_d/8\,R_0)$. (auth)

**19235** EFFECTIVE CROSS SECTION FOR REACTION $(p,p\pi^+)$. V. S. Barashenkov and V. M. Maltsev (Joint Inst. for Nuclear Research, Dubna, USSR). Acta Phys. Polon., 22: Suppl., 173-8(1962). (In English)

The cross section for reaction $(p,p\pi^+)$ that is due to peripheral interactions with the exchange of a charged $\pi$-meson was calculated. The absorption of the secondary particles in a nucleus was taken into account. The results calculated for reaction $Al^{27}(p,p\pi^+)Mg^{27}$ are compared with experimental data. In this case the experimental and theoretical cross sections are found to be close. (auth)

**19236** APPLICATION OF THE CLASSICAL SELF-CORRELATION FUNCTION TO DETERMINE THE SLOW NEUTRON SCATTERING CROSS-SECTION OF FREE MOLECULES. Krzysztof Parliński (Jagellonian Univ., Krakow). Acta Phys. Polon., 22: Suppl., 179-84(1962). (In English)

The classical selfcorrelation function $G_{cl}^{(v)}(\vec{r}t)$ is found for an atom in the molecule, considering the translation of the free molecule, its rotation and oscillation. Hence is derived the Krieger-Nelkin formula for the differential cross-section for incoherent scattering of neutron by a molecule. (auth)

**19237** NUCLEAR INTERACTIONS IN MOLECULES. SIGMA XI-RESA NATIONAL LECTURE. 1960-61. Norman F. Ramsey. Am. Scientist, 49: 509-23(Dec. 1961).

**19238** THE DECAY OF THE GROUND STATE OF $Dy^{165}$. Lars Persson, Rune Hardell, and Sam Nilsson (Nobel Inst. of Physics, Stockholm and Chalmers Inst. of Tech., Göteborg). Arkiv Fysik, 23: 1-34(1963). (In English)

The 139 min decay of $Dy^{165}$ to $Ho^{165}$ was investigated using a 50 cm $\pi\sqrt{2}$ double-focusing beta ray spectrometer, an intermediate image beta ray spectrometer, a crystal diffraction spectrometer and an intensity calibrated NaI(Tl) scintillation spectrometer. The gamma ray spectrum was studied by magnetic analysis of the photo-electrons ejected from a thin uranium converter and the relative intensities of the gamma rays are obtained after correction for the angular dependence of the photo-electric process. Gamma rays were observed with the following energies (kev) and

intensities (in parentheses): 94.68 (3700), 279.6 (565), 361.5 (1000), 478.7 (30), 500.8 (6), 514.2 (29), 545.5 (172), 565.7 (135), 575.1 (77), 587.6 (8), 621.0 (96), 633.5 (640), 695.0 (18), 715.7 (635), 995.1 (62), 1055.6 (34), and 1080.1 (104). The E2 admixture in the 94.68 kev M1 gamma ray was determined to be 2.6 per cent. M2 multipolarity is assigned to the 361.5 kev transition, M1 to the 279.6 and 633.5 kev transitions, and E1 to the 715.7 kev transition. The endpoint of the continuous beta ray spectrum, the beta ray branching ratios, and the half-life were redetermined. Based on the present observations a level scheme is proposed with excited states at 94.68, 361.5, 514.2, 715.7, 995.1, 1055.6, and 1080.1 kev. A tentative interpretation of the observed levels in terms of the collective model with Nilsson potential is given. (auth)

**19239** A SEARCH FOR LOW ENERGY TRANSITIONS IN $^{131}$Xe. W. D. Hamilton and E. Aasa (Inst. of Physics, Uppsala). Arkiv Fysik, 23: 49-56(1963). (In English)

Low energy $\gamma$ rays in $Xe^{131}$ were studied by coincidence and angular correlation methods, and their internal conversion spectrum measured using a double focusing spectrometer. The 156–210 kev cascade that was reported previously is shown to be false and due to Compton scattering. The 177 kev $\gamma$ transition is almost pure E2 ($|\delta| \geq 7$) and has an intensity of 0.32 ± 0.09% of the 364 kev $\gamma$ ray. The assignment of the single particle state $f_{7/2}$ to the 541.7 kev level is consistent with experimental results. (auth)

**19240** SEARCH FOR ALPHA ACTIVITY IN NEUTRON DEFICIENT ISOTOPES OF Pb, Tl, Hg, Pt, AND Te. M. Karras, G. Andersson, and M. Nurmia (Uppsala Univ. and Univ. of Helsinki, Finland). Arkiv Fysik, 23: 57-63 (1963). (In English)

Neutron deficient nuclides produced in the Uppsala synchrocyclotron were studied with an alpha ionization chamber, using sources of up to $10^8$ dis/min gross beta activity. The following alpha activities were observed: 3.78 ± 0.05 Mev, 10.5 ± 1.0 d, alpha branching $0.5 \times 10^{-6}$, assigned to $Pt^{188}$; 5.14 ± 0.05 Mev, 3.0 ± 0.5 min, assigned to $Hg^{188}$ or $Hg^{187}$; 5.64 ± 0.05 Mev, 53 ± 4 sec, assigned to $Hg^{186}$ or $Hg^{185}$; 6.45 ± 0.10 Mev, 33 sec, possibly due to a low-mass Bi isotope formed from lead contaminating a gold target. Upper limits varying from $10^{-9}$ to $5 \times 10^{-5}$ are set for the alpha branching of the following nuclides: $Te^{116}$–$Te^{119}$; $Au^{189}$–$Au^{193}$; $Hg^{189}$–$Hg^{193}$; $Tl^{193}$–$Tl^{195}$; $Tl^{188}$; and $Pb^{196}$–$Pb^{198}$. (auth)

**19241** LEVELS IN $Tb^{159}$ POPULATED IN THE DECAY OF $Dy^{159}$. Hans Ryde, Lars Persson, and Kärin Oelsner-Ryde. Arkiv Fysik, 23: 195-217(1963). (In English)

The electron capture decay of 144 d $Dy^{159}$ to $Tb^{159}$ was investigated with magnetic spectrometers and scintillation spectroscopy. Excited levels in $Tb^{159}$ having the energies 58.0, 137.5, and 348.1 kev are populated in this decay. The 348.1 kev level is suggested to be the expected 5/2 + [413] intrinsic state, while the 58.0 and 137.5 kev levels are the members of the 3/2 + [411] ground state rotational band. From the electron capture transition probability to the 348.1 kev level a total decay energy of 367 kev is deduced. A type of anomalous focusing in the intermediate image beta ray spectrometer is discussed in connection with the measurement of the very weak electron spectrum. (auth)

**19242** SEARCH FOR THE TWO-PHOTON DECAY OF THE 1.76 Mev 0+ LEVEL IN $Zr^{90}$. Hans Ryde (Nobel Inst. of Physics, Stockholm). Arkiv Fysik, 23: 247-58(1963). (In English)

A 0+ → 0+ nuclear transition may proceed through internal conversion (electric monopole transition), internal pair formation and two-quantum decay. Search for this possible two-photon decay of the first excited state in $Zr^{90}$, the 1.76 Mev 0+ level, was undertaken. Much care was taken to obtain a highly purified $Sr^{90}$ sample. $Sr^{90}$ decays with a half-life of 28 y to $Y^{90}$, which in turn decays to $Zr^{90}$, populating the 1.76 Mev level with a relative intensity of about 0.02%. The spectrum obtained with a sum coincidence spectrometer in a one hundred hour run, corrected for random and background coincidences, does not show the peak that would be expected from a summation of the two photons assumed to be simultaneously emitted in the decay of the 1.76 Mev level. However, from the experimental information it is possible to calculate an upper limit for the ratio of the probability of a two-photon transition T($\gamma\gamma$) to that for internal conversion T(E0). (auth)

**19243** GAMMA-GAMMA DIRECTIONAL CORRELATION IN $W^{182}$. M. S. El-Nesr, Z. Grabowski, and E. Bashandy (Uppsala Univ.). Arkiv Fysik, 23: 283-9(1963). (In English)

Gamma–gamma directional correlation experiments on the 67–264 kev, 67–1122 kev, 67–1222 kev, 100–1122 kev, 151–179 kev, and 151–1222 kev cascades in $W^{182}$ are reported. An automatic gamma–gamma coincidence spectrometer was used in the investigations. The measurements give the following spin assignments of energy levels in $W^{182}$: 1222 kev (2), 1289 kev (2), 1373 kev, (3) and 1553 kev (4,3). (auth)

**19244** SPONTANEOUS FISSION AND PREPARATION OF THE TRANSURANIUM ELEMENTS. G. N. Flerov, E. D. Donets, and V. A. Druin. At. Energ. (USSR), 14: 18-26(Jan. 1963). (In Russian)

Making use of the accumulated experimental material on spontaneous fission, G. T. Seaborg (Phys. Rev., 85: 157 (1952)) developed the first systematic theory of transuranium elements by showing the relationship between the spontaneous fission half life and the fissionability parameter. All the early transuranium elements and also elements No. 102 and 103 were prepared by using heavy ions; the preparation of a heavy element $B_Z^A$ from the target element $A_{Z_1}^{A_1}$ and an accelerated ion $I_{Z_2}^{A_2}$ is based on the nuclear reaction $A_{Z_1}^{A_1}(I_{Z_2}^{A_2},xn)B_Z^A$. The heavy ion, accelerated to an energy exceeding that of the Coulomb barrier, penetrates the target nucleus, transmitting its kinetic energy. Occasionally, a similar reaction involving the emission of an $\alpha$ particle is used. The presently reached element No. 104 is in a region in which spontaneous decay predominates in comparison with other decay modes. Radiative capture of the heavy ion represents another method of synthesis; the emission of a single energy quantum reduces the excitation energy below the fission threshold and should ultimately result in the creation of an element with a larger mass number. The exact knowledge of spontaneous fission plays an important role in the development of methods for preparing additional heavy elements. (TTT)

**19245** INVESTIGATION OF THE PROPERTIES OF $\mu$-MESOATOMS AND $\mu$-MESOMOLECULES OF HYDROGEN AND DEUTERIUM BY THE 680-Mev DUBNA SYNCHROCYCLOTRON. V. P. Dzhelepov. At. Energ. (USSR), 14: 27-37(Jan. 1963). (In Russian)

During the past years it was found that $\mu$-mesons, the mass of which is about 200 times larger than that of electrons, possess properties similar to those of electrons and thus may attach themselves to electron orbits, forming mesoatoms and mesomolecules of the various elements. The mean life of these systems is only of the order of $2.2 \times 10^{-6}$ sec. Gaseous mesocompounds of H and D were inves-

tigated, using $\mu$ and $\pi$-meson beams generated by the 680-Mev proton beam of the Dubna synchrocyclotron. The experiments were carried out in a 7000-oersted magnetic field and involved the examination of 200,000 stereophotographs by means of a measuring microscope. The transition probability of the $\mu$-mesons from proton to deuteron and the probability of the formation of pp$\mu$ mesomolecules were investigated together with the catalysis of the d + d and p + d nuclear reactions. The scattering of $\mu$-mesoatoms on protons was investigated for the first time. It was found that the large probability of the transition of $\mu$-mesons from protons to nuclei with Z > 2 is due to the interception of the mesomolecular terms in the pZ$\mu$ system; subsequent cascade transitions of mesoatoms to the ground state with nearly 100% probability are accompanied by the emission of Auger electrons with energies of several kev. (TTT)

**19246** DELAYED PROTONS. N. A. Vlasov. At. Energ. (USSR), 14: 45-7(Jan. 1963). (In Russian)

Proton-excess isotopes in which the $\beta^+$ decay energy exceeds the proton bond energy $B_p$ in the final nucleus, are expected to decay with the emission of delayed protons. The probability of such an emission of delayed protons was estimated on a theoretical basis, although the phenomenon was never observed experimentally. It was concluded that such emitters may exist near known delayed-neutron emitters, especially among the isotopes of light elements. Another possibility is presented by bombarding certain targets with accelerated $He^3$ nuclei. The reason for not having yet observed the expected product nuclei may be due to the fact that the cross section of the $(He^3,2n)$ and similar reactions, by which these nuclei may be originated, is quite small with respect to that of simpler reactions yielding other isotopes. Use of a pulsed source of $He^3$ nuclei, accelerated to >20 Mev, coupled with a suitable detector switched into the circuit between pulses, may be necessary for observing experimentally the emission of delayed protons. (TTT)

**19247** THE ISOTOPIC EFFECT IN THE ELASTIC SCATTERING OF PROTONS BY NUCLEI. A. K. Val'ter and A. P. Klyucharev. At. Energ. (USSR), 14: 48-56(Jan. 1963). (In Russian)

The availability of charged-particle accelerators made the intensive study of the interaction between protons and atomic nuclei possible; the angular distribution of the protons was found to be especially sensitive toward the effect of the individual properties of the nuclei on the elastic scattering of protons. Similar work was previously carried out with the 5.4-Mev and the 19.6-Mev linear accelerators of Physico-Techn. Inst. in Kharkov and on the cyclotron of the Physical Inst. of the Ukrainian Academy of Sciences. Results indicated that the angular dependence of the ratio of the measured and Coulomb cross sections presents a different character for nuclei with even or odd mass numbers, if the number of neutrons of the even nucleus is close to a magic number. A different situation arises if the number of nucleons in the nucleus are arranged by unit, regardless whether the nucleon is charged or not. The elastic scattering of 19.6-Mev protons was studied in the case of the following isotopes: T, $He^3$, $He^4$, $Li^6$, $Li^7$, $N^{14}$, $O^{16}$, Co, $Cu^{63}$, $Ge^{73}$, $Ge^{74}$, $Cd^{111}$, $Cd^{113}$, $Cd^{116}$, $Sn^{116}$, $Sn^{117}$, $Sn^{118}$, $Sn^{119}$, $Sn^{120}$, $Sn^{122}$, $Pb^{207}$, $Pb^{208}$, and Bi. The data obtained with Co, Cu, Cd, and Sn isotopes indicate a diffraction-type scattering; the optical model illustrates well the elastic scattering of protons on atomic nuclei. (TTT)

**19248** THE AGE OF NUCLEI AND THE PERIOD OF NUCLEAR FUSION. V. A. Davidenko. At. Energ. (USSR), 14: 100-4(Jan. 1963). (In Russian)

The age of an element may be defined as the time period counted from the cessation of active fusion phenomena up to the present time. This time period is usually determined on the basis of the decay of long-lived radioisotopes. It proposed to derive the age from laws implicit in the table of isotopes. The calculations are based on the assumption that the active fusion phase was negligibly short with respect to the lifetime of the natural radioisotopes. This implies a rapid synthesis of the elements, although in some cases longer periods are postulated. The possible reactions of the formation are considered, as e.g., the 2 uneven-uneven naturally radioactive isotopes $K^{40}$ and $Lu^{176}$ which could be formed only by an $(n,\gamma)$ reaction from $K^{39}$ and $Lu^{175}$. The age is calculated from a formula, taking the distribution of the isotopes into account. Similar formulas were derived for a number of other isotope systems. (TTT)

**19249** ANGULAR DISTRIBUTION IN THE KNOCK-ON REACTION. T. Dazai. Bull. Tokyo Inst. Technol., Spec. No. 49, 29-34(1962). (In English)

Explicit formulas of angular distribution, angular correlation, and polarization in the knock-on reaction are derived using the DWBA formalism. (auth)

**19250** THE USE OF THE $N^{14}(p,\alpha)C^{11}$ REACTION IN STUDYING THE RECOIL CHEMISTRY OF CARBON. Fulvio Cacace and Alfred P. Wolf (Brookhaven National Lab., Upton, N. Y.). Chim. Ind. (Milan), 4: 752-3(July 1962). (BNL 6103). (In Italian)

Of all the methods of producing radioactive carbon for recoil atom studies, the $N^{14}(p,\alpha)C^{11}$ seems to be one of the most promising. The yield of the recoil species is high, and the radiation dose to the system during $C^{11}$ production can be varied over a factor of $10^6$. The currently available information on the cross section for $C^{11}$ production by the $p,\alpha$ reaction is extended. The determination was made using stacked Nylon foils of known thickness. Values for the cross section were obtained for proton energies from 2 to 10 Mev. A maximum value of 0.65 b was found for protons with energy between 8 and 9 Mev. (auth)

**19251** MESIC HYPERFRAGMENTS PRODUCED IN THE INTERACTIONS OF K MESONS AT 1.5-Bev/c WITH THE NUCLEI OF IONOGRAPHIC EMULSIONS. Germain Baumann, Henri Braun, and Pierre Cueer. Compt. Rend., 256: 918-21(Jan. 21, 1963).

Fifty-one mesic hyperfragments produced in the interactions of mesons ($K^-$) at 1.5 Bev/c with the nuclei of ionographic emulsions were analyzed, and their bonding energies were calculated. The mean bonding energy found for the $He^7_\Lambda$ hyperfragment is $B_\Lambda = 3.8 \pm 0.3$ Mev. One event $C^{14}_\Lambda \rightarrow N^{14} + \pi^-$ was detected. (tr-auth)

**19252** ASYMMETRIES IN THE ELASTIC SCATTERING BY CALCIUM OF 22-Mev VECTORIALLY POLARIZED DEUTERONS. René Beurtey, Robert Chaminade, Alain Falcoz, Marie-Madeleine Faure, Robert Maillard, David McDaniels, Takashi Mikumo, André Papineau, Larry Schecter, and Jacques Thirion. Compt. Rend., 256: 922-4(Jan. 21, 1963). (In French)

A new experimental apparatus for the production of a beam of deuterons of high polarization and a detection assembly with several angles were used to make a systematic study of the angular distributions of the vectorial polarization parameter in the elastic scattering of 22-Mev deuterons and (d,p) reactions. The results of the elastic scattering on calcium are presented. (tr-auth)

**19253** PRECISION DETERMINATION OF THE MASS DIFFERENCE $Al^{27}-Mg^{24}$ FROM THE REACTIONS $Mg^{24}(\alpha,\gamma)Si^{28}$ AND $Al^{27}(p,\gamma)Si^{28}$. A. Rytz, H. H. Staub,

H. Winkler, and F. Zamboni (Universität, Zurich). Helv. Phys. Acta, 35: 546-8(1962). (In English)

In order to examine a difference of about 11 kev in the excitation energy of several excited levels of $Si^{28}$, absolute precision measurements of two corresponding resonances of the two reactions $Mg^{24}(\alpha,\gamma)Si^{28}$ and $Al^{27}(p,\gamma)Si^{28}$ were made. The measured values of the two corresponding resonances are $Mg^{24}(\alpha,\gamma)$: $E_\alpha = 2437.4 \pm 1$ kev and $E_\alpha = 3199.8 \pm 1$ kev and $Al^{27}(p,\gamma)$: $E_p = 504.88 \pm 0.15$ kev and $E_p = 1183.25 \pm 0.25$ kev. This gives a mass difference from the higher resonances $Al^{27} - Mg^{24}$: $3\,\underline{m}_u - (3261.6 \pm 1.0)$ kev and from the lower resonances $3\,\underline{m}_u - (3262.3 \pm 1.0)$ kev, in disagreement with Everling's mass tables. (J.S.R.)

**19254** ANGULAR CORRELATION MEASUREMENTS OF THE STRIPPING REACTION $Ne^{20}(d,n\gamma)Na^{21}$. W. Grueb-ler and W. R. Gibbs (Université, Neuchâtel, Switzerland). Helv. Phys. Acta, 35: 548-9(1962). (In German)

Angular correlation measurements were made of the $Ne^{20}(d,n\gamma)Na^{21}$ reaction at $\Theta = 0°$ and deuteron energies of 1.84 and 2.87 Mev. The results show that the angular correlation function is energy independent. The spin of the first excited state of $Na^{21}$ is $^5/_2$. These results suggest that a strong spin-orbit interaction effect or another reaction mechanism is involved. (J.S.R.)

**19255** CROSS SECTION FOR THE PRODUCTION OF RARE GASES FROM Mg, Al, Fe, Ni, Cu, AND Ag AFTER IRRADIATION WITH 540-Mev PROTONS. R. H. Bieri (Universität, Zurich and Universität, Bern) and W. Rutsch. Helv. Phys. Acta, 35: 553-4(1962). (In German)

From a series of targets irradiated in the CERN synchrocyclotron, the rare gases were extracted and measured in the Omegatron mass spectrometer. The irradiation was carried out in the "internal beam" on 14-mm targets. The number of protons incident on the target was determined. The metals used as targets were not degassed and contained before irradiation considerable quantities of rare gases, principally $He^4$. The results obtained in the rare gas analysis for the various metal targets were tabulated. (J.S.R.)

**19256** POLARIZED GAMMA-GAMMA ANGULAR CORRELATIONS AND DECAY SCHEME OF $Nd^{144}$. J. F. Bakken, R. Hess, and J. W. Sunier (Swiss Federal Inst. of Tech., Zurich). Helv. Phys. Acta, 35: 555-7(1962). (In French)

The $\gamma_1$-$\gamma_2$ directional angular correlation between the 1490 and 690 kev radiation of $Nd^{144}$ was measured. A spin 1 was attributed to the 2.18 level and the value $|\delta| \leq 0.015$ to the multipolar mixing parameter of the $\gamma_2$ transition. The parity of the 2.18-Mev level was also determined. The $\gamma_2$ transition of 1490 kev is E1, which assigns to the 2.18-Mev level a negative parity. The $1^-$ level at 2.18 Mev seems to be an octupolar vibration level. (J.S.R.)

**19257** HYPERFINE STRUCTURE OF THE $8\,^2P_{\frac{1}{2}}$ STATE OF CESIUM-133. Philippe Barbey and Edmond Geneux (Institut de Physique Expérimentale, Geneva). Helv. Phys. Acta, 35: 561-2(1962). (In French)

Recent determinations of the hfs of the $7\,^2P_{\frac{1}{2}}$ state of $Cs^{133}$, combined with the values of the fine structure, permitted the calculation of the hfs of the $8\,^2P_{\frac{1}{2}}$ state. The results obtained were compared with the experimental values from an interferometric study. A non-systematic deviation of the $\nu_{F-F-1}$ frequency slopes was observed. The value of A calculated from experimental values agrees with the theoretical value. (J.S.R.)

**19258** DETERMINATION OF THE HALF-LIFE OF EXCITED STATES IN NUCLEI. Ping-Lai Wang. Ho Tsu K'o Hsueh, 3: No. 4, 1-5(1962). (In Chinese)

The half life of the excited state in $Ta^{181}$ was determined on the basis of the decay of $Hf^{181}$. The measurements were carried out by means of $\beta$-$\gamma$ coincidence counting, using an energy spectrum apparatus for determining the energy levels. The half life was found to be $20.48 \times 10^{-6}$ sec. (TTT)

**19259** THE DECAY SCHEME OF MANGAGESE-56. Shiao-Hua Hsii and Ying-Chen Yang. Ho Tsu K'o Hsueh, 3: No. 4, 7-14(1962). (In Chinese)

An exploratory measurement was undertaken for determining the half life of $Mn^{56}$. The tests were carried out by means of a specially prepared specimen, obtained by exposing a thin layer of $MnO_2$ to thermal neutrons. A $\gamma$-$\gamma$ coincidence counter and energy spectrum measurements were used. Results indicate that $Mn^{56}$ decays into $Fe^{56}$ with 3 excited states at energy levels of 0.845, 2.65, and 2.98 Mev. (TTT)

**19260** DETERMINATION OF SOURCE SELF-ABSORPTION IN THE STANDARDIZATION OF ELECTRON-CAPTURING RADIONUCLIDES. S. B. Garfinkel and J. M. R. Hutchinson (National Bureau of Standards, Washington, D. C.). Intern. J. Appl. Radiation Isotopes, 13: 629-39(Nov.-Dec. 1962). (In English)

A method is described for measuring source self-absorption in the standardization of radionuclides that decay by electron capture directly to the ground state. Auger electrons are used as a tracer in order to determine the x-ray absorption. Data are presented that indicate that x-ray absorption in a certain type of electroplated source is less than 0.2%. A method for determination of ejected photoelectrons from absorbing foils in $4\pi$ x-ray counting is described. (auth)

**19261** ISOMERIC STATES OF $^{92}$Nb. E. T. Bramlitt and R. W. Fink (Univ. of Arkansas, Fayetteville). J. Inorg. Nucl. Chem., 24: 1317-20(Dec. 1962). (In English)

The existence of isomeric states of $Nb^{92}$ with half lives of 21.6 hr, 13 hr, 5.9 $\mu$sec, and 191 min has been reported in the literature. Evidence is presented that indicates that all but the 5.9-$\mu$sec isomer are in error. The following total activation cross sections for 14.7-Mev neutrons were measured: $Mo^{92}(n,p)Nb^{92}$ (10.1 days + 5.9 $\mu$sec), 60 ± 15 mbarns; and $Mo^{92}(n,\alpha)Zr^{89}$ (79.0 hr + 4.4 min), 20 ± 8 mbarns. (P.C.H.)

**19262** ABSOLUTE ACTIVATION CROSS SECTIONS FOR REACTIONS OF NIOBIUM WITH 14.5 Mev NEUTRONS. E. T. Bramlitt and R. W. Fink (Univ. of Arkansas, Fayetteville). J. Inorg. Nucl. Chem., 24: 1321-5(Dec. 1962). (In English)

Absolute neutron activation cross sections at 14.5 Mev were measured for the mono-isotopic nuclide, $Nb^{93}$, by means of $\gamma$-scintillation spectroscopy and $\beta$-proportional counting as well as by the use of chemical separation techniques. The observed reactions, product half lives, and cross sections are: $Nb^{93}(n,2n)Nb^{92g}$, 10.1 days, 499 ± 91 mbarns; $Nb^{93}(n,\gamma)Nb^{94m}$, 6.6 min, 0.44 ± 0.25 mbarns; $Nb^{93}(n,\alpha)Y^{90g}$, 64 hr, 8.6 ± 2.5 mbarns; $Nb^{93}(n,\alpha)Y^{90m}$, 3.0 hr, 5.9 ± 2.0 mbarns; $Nb^{93}(n,n'\alpha)Y^{89m}$, 16 sec, 2.5 ± 1.1 mbarns. No activity was observed in the zirconium fraction, the (n,p) product, nor was the 13-hr $Nb^{92m}$ produced through an (n,2n) reaction. Half lives of $Y^{90m}$ and $Y^{89m}$ were determined by least squares analysis to be 3.02 ± 0.09 hr and 16.3 ± 1.3 sec, respectively. (auth)

**19263** MASS DISTRIBUTION IN THE SPONTANEOUS FISSION OF $^{240}$Pu. J. B. Laidler and F. Brown (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). J. Inorg. Nucl. Chem., 24: 1485-92(Dec. 1962).

The distribution of mass in the spontaneous fission of $Pu^{240}$ was investigated radiochemically by measuring the

fission yields of fifteen isotopes in the mass range 89 to 147. Comparisons are made with other published work on spontaneous fission to reveal trends in the yield-mass relationship with increasing mass of the fissioning nucleus. Since neutron-induced fission of $Pu^{239}$ is essentially fission of $Pu^{240}$ in excitation levels above the ground state, a further series of changes in the yield-mass function for fission in various states of excitation of the same nucleus is also presented. (auth)

**19264** THE RATIO OF NEUTRON CAPTURE TO FISSION FOR URANIUM-235. M. J. Cabell and L. J. Slee (Atomic Energy Research Establishment, Harwell, Berks, Eng.). J. Inorg. Nucl. Chem., 24: 1493-1500(Dec. 1962). (AERE-3986)

Alpha (the ratio of neutron capture to fission) for $U^{235}$ was measured at nine different points along a flux scanning tube of the reactor PLUTO. Experimental values for $\alpha$ varied from 0.178 to 0.189. Correcting all the results to 2200 m/sec neutrons gave a mean value for $\alpha_0$ of 0.1725 ± 0.0034 (standard error), a result in excellent agreement with present recommended values. (auth)

**19265** RADIATIONS FROM SHORT-LIVED RARE GAS FISSION PRODUCTS. M. A. Wahlgren and W. W. Meinke (Univ. of Michigan, Ann Arbor). J. Inorg. Nucl. Chem., 24: 1527-38(Dec. 1962). (TID-12807)

The energies of the primary $\gamma$ rays emitted in the decay of 3.2 min $Kr^{89}$, 33 sec $Kr^{90}$, 1.2 min $Rb^{91m}$, 41 sec $Xe^{139}$, and 66 sec $Cs^{140}$ were determined and relative $\gamma$-ray intensities measured. Photon per disintegration values were estimated for $Kr^{89}$, $Kr^{90}$, $Xe^{139}$, and for 9.5 min $Cs^{139}$. $\beta$-ray energy endpoints were measured for $Kr^{89}$, $Kr^{90}$, $Xe^{139}$, and $Cs^{139}$, and lower limits established for the decay energies of these nuclides. A simple and rapid gas chromatographic separation which was developed for these studies is described. (auth)

**19266** PROMETHIUM 147 HYPERFINE STRUCTURE UNDER HIGH RESOLUTION. Joseph Reader and Summer P. Davis (Univ. of California, Berkeley). J. Opt. Soc. Am., 53: 431-5(Apr. 1963).

The hyperfine structure of $Pm^{147}$ was investigated with Fabry-Perot interferometers. Well-resolved patterns of about 800 lines were obtained. The results confirm the previous spectroscopic determination of the nuclear spin, but show that the previous value of the nuclear magnetic moment as derived from spectroscopic data cannot be considered meaningful. (auth)

**19267** THE HALF LIFE OF $Tb^{157}$. Shiro Iwata, Ichiro Fujiwara, Tomota Nishi, Shiro Goda, Masayuki Tabushi, and Tsunenobu Shigematsu (Kyoto Univ.). J. Phys. Soc. Japan, 18: 315-16(Feb. 1963).

A sample of $Gd_2O_3$ was bombarded for four hours with 38.5-Mev $\alpha$ particles and the activity of $Dy^{157}$ produced by the $(\alpha,3n)$ reaction was separated from the target material. Terbium was separated from dysprosium by an ion-exchange method. The decay rate of $Tb^{157}$ nuclei was determined from the counting rate of the K x rays in a well type crystal, and the K and L electron capture ratio was measured using a NaI(Tl) crystal covered with Al, corrected for absorption by the Al cover, self absorption, photopeak efficiency, and fluorescence yield. The half life of $Tb^{157}$ was estimated at 160 ± 40 yr; a decay mode was proposed. (C.E.S.)

**19268** SOME INVESTIGATIONS ON THE PREPARATION OF CARRIER-FREE $Mn^{54}$ AND A MIXTURE OF THE CARRIER-FREE COBALT ISOTOPES $Co^{56}$, $Co^{57}$, AND $Co^{58}$ FROM IRON. K. Wagner (Zentralinstitut für Kernphysik, Bereich Radiochemie, Rossendorf, Ger.). Kernenergie, 5: 853-9(Dec. 1962). (In German)

The $Mn^{54}$ produced in the irradiation of iron with 13.5-Mev deuterons in the Rossendorf Cyclotron was separated carrier-free by ion exchange from the radioisotopes $Co^{56}$, $Co^{57}$, and $Co^{58}$ after extraction of most of the iron with ether. The ion exchange resin SBW was suitable with elution with strong HCl. First manganese was eluted, and then cobalt, and the residual iron remained in the column. The $Mn^{54}$ and the Co isotopes were obtained in yields of more than 95%. From measurements of the $\gamma$ dose output and evaluation of the $\gamma$ spectra, data on the activities arising were obtained and compared with values from the literature. The $\gamma$ dose output constant of $Co^{56}$ was calculated from known data on $\gamma$ and positron radiation to be 19 r/hr. (tr-auth)

**19269** INVESTIGATION OF INTERACTIONS CAUSED BY 9 Bev PROTONS IN EMULSION PLATES. Gyoergy Bozóki, Ervin Fenyves, and Éva Gombosi. Magy. Tud. Akad. Kozp. Fiz. Kut. Int. Kozlemen., 6: 351-7(Sept.-Oct. 1958). (In Hungarian)

A method was worked out for determining the number of nucleons involved in a 9-Bev proton reaction with a nucleus. The correlation between the values of $\eta$ determined in this way and the number of emitted shower particles $n_s$ as well as that between $\eta$ and the number of evaporation particles $N_h$ were investigated. The results obtained show significant correlation between $\eta$ and $n_s$ and between $\eta$ and $N_h$, respectively. (auth)

**19270** POLARIZATION OF $\beta$-PARTICLES IN $Li^8$-DECAY. Lajos Keszthelyi and Josef Zimányi. Magy. Tud. Akad. Kozp. Fiz. Kut. Int. Kozlemen., 6: 358-60 (Sept.-Oct. 1958). (In Hungarian)

Circular polarization of the bremsstrahlung produced by the $\beta$ particles emitted in $Li^8$ decay was measured. The polarization is concluded from that of the bremsstrahlung and by comparing the result thus obtained to that of the $\beta-\bar{\nu}$ angular correlation measurements carried out by Mayer-Leibnitz et al. It was found that the spin of the antineutrino produced in $\beta$ decay is oriented in the direction of the momentum of the antineutrino. (auth)

**19271** CIRCULAR POLARIZATION OF GAMMA-RAYS FOLLOWING THE EMISSION OF POLARIZED HEAVY PARTICLES. Jozsef Zimányi. Magy. Tud. Akad. Kozp. Fiz. Kut. Int. Kozleman., 6: 361-6(Sept.-Oct. 1958). (In Hungarian)

Circular polarization of gamma rays following the emission of heavy particles was calculated. It was found that circular polarization of gamma rays is proportional to the polarization of the emitted heavy particles. Correlation between the two polarizations can be expressed by known functions of an intrinsically geometrical nature. (auth)

**19272** LIFETIME OF THE 74.6 kev LEVEL IN $Np^{239}$. Per Rex Christensen (Universitet, Copenhagen). Nucl. Phys., 41: 17-20(Feb. 1963). (In English)

The half life of the 74.6 kev level in $Np^{239}$ was measured using the delayed coincidence method. The result obtained is $T_{\frac{1}{2}} = 1.40 \pm 0.06$ ns. (auth)

**19273** THE BETA DECAY OF $Pa^{233}$. K. M. Bisgård, P. Dahl, P. Hornshoej, and A. B. Knutsen (Univ. of Aarhus, Denmark). Nucl. Phys., 41: 21-31(Feb. 1963). (In English)

Results of a detailed study of the 27 d decay of $Pa^{233}$ are presented. A six gap and a single gap beta ray spectrometer were used for measurements of the internal conversion electron spectrum, the beta ray spectrum and of electron-gamma coincidences. Beta transitions with end-point

energies of 578 ± 10 kev (12%), 254 ± 5 kev (56%), and 154 ± 5 kev (32%) are found. The intensities differ slightly from the intensities found by others. The shape and the corresponding log ft value of the high energy transition agree with the assumption of a first forbidden, hindered transition ($\Delta I = 1$, $\Delta K = 2$). A K conversion coefficient equal to 0.69 ± 0.07 was determined for the 312 kev magnetic dipole transition by repeated measurements of electron-gamma coincidences. The gyromagnetic ratios $g_\Omega$ and $g_R$ for the ground state of $U^{233}$ are calculated from the mixing ratio of the 40 kev transition and these values are compared with results reported by other authors. (auth)

**19274** LEVELS IN $W^{184}$ POPULATED IN THE DECAY OF $Re^{184}$. K. M. Bisgård, C. Sharp Cook, P. Hornshoej, and A. B. Knutsen (Univ. of Aarhus, Denmark). Nucl. Phys., 41: 32-46(Feb. 1963). (In English)

The decay of 35 d $Re^{184}$ was studied by means of a six gap beta ray spectrometer and scintillation spectrometers including electron-gamma and gamma-gamma coincidence techniques. Relative intensities of all transitions between the gamma-vibrational band and the ground state rotational band in $W^{184}$ indicate a mixing factor z = 0.052. Two levels (at 1157 kev and 1226 kev) are observed above the gamma-vibrational band. Uncertainties still exist as to the character of these states. (auth)

**19275** ODD-EVEN SHIFT AND MOMENTS OF INERTIA FOR K = 0 ROTATION BANDS OF ODD NUCLEI. B. J. Verhaar (Technische Hogeschool, Eindhoven, Netherlands). Nucl. Phys., 41: 53-7(Feb. 1963). (In English)

A displacement of energy levels (so-called odd-even shift) was observed in the K = 0 rotation band of odd deformed nuclei. It is shown that the theory of collective rotation proposed by Peierls and Yoccoz explains this displacement, but predicts in addition different moments of inertia for the even and odd spin levels. A discussion is presented in terms of the unified model, on the basis of which an explanation of the odd-even shift was given previously. (auth)

**19276** CHARGE SYMMETRY IN THE MIRROR REACTIONS $Li^6(d,p)Li^7$ AND $Li^6(d,n)Be^7$. M. Birk, G. Goldring, P. Hillman, and R. Moreh (Weizmann Inst. of Science, Rehovoth, Israel). Nucl. Phys., 41: 58-67(Feb. 1963). (In English)

A comparative study of the $Li^6(d,p)Li^7$ and $Li^6(d,n)Be^7$ reactions was made in order to serve as a critical test of the principle of charge symmetry in nuclear reactions. The ground and first excited states of $Li^7$ and $Be^7$ are believed to be pure isobaric spin doublets. The need for substantial Coulomb and phase space corrections was eliminated since the ratios of the ground to first excited state cross sections are compared. The observed equality of the neutron and proton results over the bombarding energy range 0.4-3.2 Mev may be taken as a striking and model independent confirmation of the principle of charge symmetry. An interesting anomaly in the angular distribution results was observed that does not seem explainable in ordinary distorted wave stripping theory. (auth)

**19277** TRANSVERSE POLARIZATION OF K- AND L-CONVERSION ELECTRONS FOLLOWING THE BETA DECAY OF $Hg^{203}$. W. Juengst and D. Schmicker (Technische Hochschule, Karlsruhe, Ger. and Kernforschungszentrum, Karlsruhe, Ger.). Nucl. Phys., 41: 68-72(Feb. 1963). (In English)

The degree of transverse polarization of internal K- and L-conversion electrons following the beta decay of $Hg^{203}$ was measured. In both cases the polarization vector was found to be antiparallel to the momentum of the preceding beta particle. Comparison of the experimental and theoretically calculated results indicates that the ground state spin of $Hg^{203}$ will be $3/2$ or $5/2$. (auth)

**19278** A DETERMINATION OF THE SPIN OF $_\Lambda Li^8$. D. H. Davis, R. Levi Setti, and M. Raymund (Univ. of Chicago). Nucl. Phys., 41: 73-7(Feb. 1963). (In English)

Evidence is presented that shows that the decay $_\Lambda Li^8 \rightarrow \pi^- + He^4 + He^4$ proceeds almost exclusively through states of $Be^8$. The predominance of the 2.9 Mev $2^+$ $Be^8$ level together with the angular distribution of the decay products for events involving this level suggest that the spin of $_\Lambda Li^8$ is one. (auth)

**19279** HYPERNUCLEUS $_\Lambda Li^8$ AND THE DECAY PROCESS $_\Lambda Li^8 \rightarrow \pi^- + He^4 + He^4$. R. H. Dalitz (Univ. of Chicago). Nucl. Phys., 41: 78-91(Feb. 1963). (EFINS-62-49) (In English)

The selection rules for the decay sequence $_\Lambda Li^8 \rightarrow \pi^- + Be^{8*}$, $Be^{8*} \rightarrow He^4 + He^4$ are discussed and estimates are made of the transition rates and the angular distributions as function of the $_\Lambda Li^8$ spin J using intermediate coupling nuclear wave-functions. A simple interpretation of the results obtained is given in terms of the L-S coupling limit. The outstanding features of the data on this process are fitted naturally only for $J = 1^-$. (auth)

**19280** ON THE NUMBER OF NEUTRONS EMITTED BY $U^{234}$ AND $Pu^{240}$ IN THE SYMMETRICAL FISSION REGION. V. F. Apalin, Yu. N. Gritsyuk, I. E. Kutikov, V. I. Lebedev, and L. A. Mikaelyan (Kurchatov Atomic Energy Inst., Moscow). Nucl. Phys., 41: 92-4(Feb. 1963). (In English)

The number of neutrons $\nu$ emitted by $U^{234}$ and $Pu^{240}$ is measured for different ratios of fragment masses. A sharp increase of $\nu$ is detected in the symmetrical fission region. The dependence of $\nu$ on the mass ratios correlates well with the total kinetic energy of the fragments. (auth)

**19281** FINE STRUCTURE OF $\alpha$-RADIATION OF $Pu^{239}$. S. A. Baranov, V. M. Kulakov, and S. N. Belenkii (Belenky) (Kurchatov Atomic Energy Inst., Moscow). Nucl. Phys., 41: 95-100(Feb. 1963). (In English)

The radioactive decay of $Pu^{239}$ is investigated with a magnetic $\alpha$-spectrograph. Analysis of the $\alpha$-spectrum of $Pu^{239}$ revealed more than 20 $\alpha$ groups of fine structure, a considerable portion of which was detected for the first time. A possible interpretation is discussed of the energy levels of the nucleus $U^{235}$ pointing to the existence of a new band of levels based on the orbit $5/2^+$. The $U^{235}$ energy level scheme is given. (auth)

**19282** ON THE THEORY OF ROTATION STATES OF DEFORMED AXIAL SYMMETRY IN EVEN NUCLEI. A. Gustavs and E. O. Steinborn (Kernphysikalisches Institut, Deutsche Akademie der Wissenschaften, Berlin). Nucl. Phys., 41: 101-17(Feb. 1963). (In German)

On the basis of the liquid drop model the variation of deformation $\epsilon$ due to the centrifugal pressure in a rotating nucleus is calculated. This additional deformation $\Delta\epsilon$ depends on the rotational level and the restoring force in the nucleus. In this way the moment of inertia $\mathcal{J} = \mathcal{J}_0\epsilon^2$ depends somewhat on the rotational state, giving a deviation from the level sequence $I(I + 1)$ depending on the parameter $\Delta\epsilon(2)/\epsilon_0$ that represents the relative change of deformation in the first rotational state. The parameter is determined for a number of nuclei from the experimental rotational bands, using only the level sequences related to the first rotational state. In this way the unknown constant $\mathcal{J}_0$ is eliminated. The bands found experimentally are in good agreement with the theoretical ones for each order of

magnitude of $\Delta\epsilon(2)/\epsilon_0$. This parameter determines the restoring force that in turn yields the $\beta$-vibrational states using the hydrodynamical mass parameter $B_2$. The dependence of the restoring force on the neutron number N shows an appreciable maximum in the middle of closed shells at 82 and 126 that appears also in the N dependence of the theoretical $\beta$-vibrational states and is in agreement with the N dependence of the energy of the experimentally found vibrational states. Using the hydrodynamical $B_2$ values the theoretical vibrational levels agree with the experimental ones within a factor 1.7. The real $B_2$ values do not seem to depend on shell structure. It is interesting to compare the rotational bands on the second $2^+$ level in heavy nuclei with our theoretical ones calculated with the parameter value found for the ground state band. (auth)

**19283** MONOPOLE ELASTIC AND INELASTIC SCATTERING OF HIGH ENERGY ELECTRONS. G. R. Bishop (Laboratoire de l'Accélérateur Linéaire, Orsay, France). Nucl. Phys., 41: 118-29(Feb. 1963). (In English)

Differences in the charge density distributions of $O^{16}$ and $O^{18}$ are attributed to a deformation of the core of $O^{18}$, and a deformation parameter is derived from analysis of the elastic form factors obtained by studies of electron scattering. The same deformation parameter leads to a calculated transition probability to the first excited state in satisfactory agreement with that measured by electron inelastic scattering. An inelastic E0 transition in $S^{32}$ is analysed in terms of the collective model leading to deformation parameters that render good account of other features of the inelastic electron scattering experiments. (auth)

**19284** STRUCTURE OF PLATINUM NUCLEI. I. NEW DECAY SCHEME OF $Au^{196}$. Hidetsugu Ikegami, Kazusuke Sugiyama, Toshimitsu Yamazaki, and Mitsuo Sakai (Tokyo Univ.). Nucl. Phys., 41: 130-58(Feb. 1963). (In English)

Nuclear structure of $Pt^{196}$ was investigated from the decay of the 6.2 d $Au^{196}$. New weak gamma rays of 312, 444, 522, 568, 644, 757, 762, and 1090 kev were found in the analysis of conversion electron spectra by the use of a sector-type double focusing beta ray spectrometer. These new gamma rays were all coincident with the 356 kev gamma transition between the first and ground state of $Pt^{196}$. From the ratio of electron capture to positon emission rate $\epsilon_{K,L,M.}/\beta^+ = 2.0 \pm 0.4 \times 10^5$, the electron capture decay energy of the 6.2 d $Au^{196}$ is estimated as $1480\pm\frac{8}{12}$ kev. Directional correlation measurements of 1090-356, 760-340, 530-340, and 333-356 kev gamma ray cascades were also performed. The level scheme of $Pt^{196}$ is proposed as follows: 1446 kev, $3^-$: (1316 kev, $3^+$, $2^+$): 1117 kev, $2^+$; 1002 kev, $3^+$: 877 kev, $4^+$; 689 kev $2^+$; 356 kev, $2^+$. The 1446 kev $3^-$ state is assigned as the lowest octupole vibrational state. Almost all these levels are compared with ones determined from the measurement of the $Pt^{196}(d,p)Pt^{196}$ reaction. The large excitation of the $3^-$ state by the stripping process seems to be difficult to understand on the basis of any of the usual theories. The extremely low value of the 689 kev cross over transition from the second excited $2^+$ state, 689 K/356 K = $1.0 \pm 1.0 \times 10^{-5}$ is discussed in terms of intrinsic nucleonic excitations. (auth)

**19285** ENERGY LEVEL SPACING DISTRIBUTIONS. Peter B. Kahn (Brookhaven National Lab., Upton, N. Y.). Nucl. Phys., 41: 159-66(Feb. 1963). (BNL-6392) (In English)

The probability function $P^1(s)$ for the next-nearest neighbor spacing in the infinite dimensional limit, is computed and compared with Porter's result for $3 \times 3$ random real symmetric matrices. The probability function for Dysón's unitary ensemble $\beta = 2$; $P^2(s; 2)$, for the nearest neighbor spacing, is also computed. It is compared with results for $2 \times 2$ random hermitian matrices. (auth)

**19286** AN ABSOLUTE MEASUREMENT OF THE $^6$He DECAY ENERGY. C. H. Johnson, Frances Pleasonton, and T. A. Carlson (Oak Ridge National Lab., Tenn.). Nucl. Phys., 41: 167-72(Feb. 1963). (In English)

The end-point of the energy spectrum of recoil ions from the $\beta$ decay of $He^6$ was observed with a spectrometer that is calibrated in terms of a standard voltage cell. The average of two independent measurements gives a maximum $\beta$ energy of 3508 ± 4 kev. This result is weighted with other measurements to give a maximum $\beta$ energy of 3508.4 ± 3.8 kev. Addition of the 1.4 kev maximum recoil energy yields the decay energy 3509.8 ± 3.8 kev. (auth)

**19287** PRODUCTION CROSS-SECTIONS AND NEUTRON POLARIZATION IN (p,n) REACTIONS AT 143 Mev. P. H. Bowen (Atomic Energy Research Establishment, Harwell, Berks, Eng.), G. C. Cox, G. B. Huxtable, J. P. Scanlon, J. J. Thresher, A. Langsford, and H. Appel. Nucl. Phys., 41: 177-84(Mar. 1963). (In English)

Measurements are made of the energy spectra and polarizations of neutrons emitted at a laboratory angle of 45° from deuterium, lithium, and aluminum bombarded by protons of 143 Mev. The results are consistent with the view that neutron production from deuterium proceeds mainly by single quasi-free proton-neutron scattering but that multiple scattering effects predominate in heavier nuclei. (auth)

**19288** POSITON-DECAY OF $Te^{121}$ AND THE EXCITED STATES OF $Sb^{121}$. R. Bhattacharyya and S. Shastry (Saha Inst. of Nuclear Physics, Calcutta). Nucl. Phys., 41: 184-91(Mar. 1963). (In English)

A $\beta^+$ group from the $Te^{121}$ nucleus is found to have an end energy ≈ 260 kev. The highest excited state is found to be at 1130 kev, which is found to decay with a half life of 11.0 nsec to the ground state by the emission of a 1130-kev gamma ray and a 1060-70 kev cascade. The $\gamma$-$\gamma$ directional correlations are measured for the possible cascades and a decay scheme is proposed. (auth)

**19289** 14.8 Mev NEUTRON ACTIVATION CROSS-SECTION MEASUREMENTS OF A FEW TELLURIUM ISOTOPES. N. K. Majumdar and A. Chatterjee (Saha Inst. of Nuclear Physics, Calcutta). Nucl. Phys., 41: 192-201 (Mar. 1963). (In English)

The activation cross sections of the (n,2n) and (n,$\alpha$) products of different tellurium isotopes for 14.8-Mev neutrons are measured. Enriched isotopes are used to determine the (n,2n) cross sections of the 9.36-hr $Te^{127}$, 67.5-min $Te^{129}$, and 33-day $Te^{129}$ activities relative to the $Al^{27}$ (n,p)$Mg^{27}$ cross section. By means of chemical separation, the 27-hr $Sn^{121}$, 39.7-min $Sn^{123}$ and 2.45-hr $Sn^{127}$ activities are compared among themselves in tellurium-free samples. The three tin cross sections are finally obtained from decay analyses of quickly separated Sn-products by comparing with the 67.5-min $Te^{129}$ residual activity as internal standard. The 9.7-min $Sn^{125}$ cross section is also determined. An activity ≈ 2 min is noticed. Analyses of the combined (n,$\alpha$) data in the heavy element region suggest the presence of flat peaks in the observed cross sections away from magic numbers. The simple evaporation theories do not predict such peaks. (auth)

**19290** THE $O^{16}(t,p\gamma)O^{18}$ REACTION. F. H. Read and J. M. Calvert (Univ. of Manchester, Eng.). Nucl. Phys., 41: 210-20(Mar. 1963). (In English)

Differential cross sections and proton-gamma angular correlation functions in the reaction plane at six different

proton angles are measured for the $O^{16}(t,p\gamma)O^{18}$ reaction through the first excited state (1.98 Mev) of $O^{18}$, using tritons of energy 5 Mev. The results are analyzed in terms of the plane-wave Born approximation "lump" theory of two-nucleon stripping. (auth)

**19291** THE DECAY OF $Cs^{132}$. H. W. Taylor (Univ. of Alberta, Edmonton), G. N. Whyte, and R. McPherson. Nucl. Phys., 41: 221-6(Mar. 1963). (In English)

The decay of $Cs^{132}$ is studied with scintillation spectrometers. Gamma rays are observed with the following energies (and relative intensities): 485 ± 20 (1.7), 635 ± 20 (0.7), 667.9 ± 0.4 (100), 880 ± 20 (0.04), 960 ± 20 (0.03), 1035 ± 10 (0.2), 1140 ± 10 (0.5), and 1320 ± 10 (0.73) kev. The gamma rays at 485 and 1035 kev are attributed to the de-excitation of levels at these energies in $Ba^{132}$ following the $\beta$-decay of $Cs^{132}$; all the others are attributed to transitions in $Xe^{132}$ following electron capture of positron emission. Positron branching to the 668-kev level in $Xe^{132}$ is observed with an intensity of 0.3 to 0.6%. The end-point energy of the positron spectrum is 400 × 25 kev, corresponding to an energy difference of 2090 ± 25 kev between the ground states of $Cs^{132}$ and $Xe^{132}$. (auth)

**19292** AN INVESTIGATION OF THE ENERGY LEVELS OF $A^{38}$ AND $K^{38}$. I. J. Taylor (Univ. of Manchester, Eng.). Nucl. Phys., 41: 227-35(Mar. 1963). (In English)

The energy levels of $Ar^{38}$ and $K^{38}$ are investigated by means of the reaction $K^{39}(t,\alpha)Ar^{38}$ at an incident triton energy of 5.48 Mev and the reaction $Ca^{40}(d,\alpha)K^{38}$ at an incident deuteron energy of 5.46 Mev. The reaction products are analyzed using a broad-range magnetic spectrograph. Eleven energy levels are assigned to $Ar^{38}$ up to an excitation energy of 6.06 Mev, and twelve energy levels are assigned to $K^{38}$ up to an excitation energy of 3.98 Mev. Absolute values of differential cross sections are determined. The observed energy level spectra are compared with the spectrum predicted from an intermediate-coupling calculation of the mass-38 system. (auth)

**19293** ON THE THEORY OF MUON CAPTURE BY COMPLEX NUCLEI. [PART] I. J. R. Luyten, H. P. C. Rood, and H. A. Tolhoek (Univ. of Groningen, Netherlands). Nucl. Phys., 41: 236-74(Mar. 1963). (In English)

Various nuclear models and methods of calculation for total muon capture rates by complex nuclei are compared. The statistical model is worked out for N = Z nuclei. Calculations with a simple shell model are made with and without the use of the closure approximation for wave functions calculated with the following potential wells: harmonic oscillator well; infinite potential well; and finite potential well. Various corrections are considered, e.g., the influence of the velocity dependent terms. Numerical results are given for $O^{16}$ and $Ca^{40}$. The various models are in reasonable mutual agreement and the closure approximation turns out to be reasonable. The coupling constants derived from the experimental capture rates for $O^{16}$ and $Ca^{40}$ agree with each other within 10%, but are about 50% lower than the value required according to a universal Fermi interaction. The deviation from this value may arise from the use of wave functions in the models that are not sufficiently realistic. (auth)

**19294** EXCITATION FUNCTIONS FOR THE REACTIONS INDUCED BY ALPHA PARTICLES ON $Ag^{107}$. S. Fukushima, S. Hayashi, S. Kume, H. Okamura, K. Otozai, K. Sakamoto, and Y. Yoshizawa (Osaka Univ.). Nucl. Phys., 41: 275-97(Mar. 1963). (In English)

Cross sections of reactions induced by alpha particles on $Ag^{107}$ are measured up to 40 Mev by means of the radiochemical method with stacked foil targets. Observed excitation functions are for the $(\alpha,n)$, $(\alpha,2n)$, $(\alpha,3n)$, $(\alpha,pn)$, $(\alpha,\alpha n)$, and $(\alpha,\alpha 2n)$ reactions. For the $(\alpha,\alpha n)$ reaction the cross sections for one of the isomeric pair are determined. Excitation functions are calculated in terms of the statistical theory, using capture cross sections based on the diffuse-surface optical model and the level density $W(E) = C \exp[2\{a(E-\delta)\}^{\frac{1}{2}}]$. Adopting $a = 3$ Mev$^{-1}$ and pairing-energy values for $\delta$, the experimental results are explained by the theory. Isomeric cross sections are obtained for the $(\alpha,n)$ and $(\alpha,3n)$ reactions. The ratios of higher spin states to lower spin states increases as the energies of alpha particles increase. The ratio is about twenty at 40 Mev for the $(\alpha,3n)$ reaction. (auth)

**19295** (n,$\alpha$) AND (n,p) REACTIONS IN SILICON AT NEUTRON ENERGIES UP TO 5.5 Mev. R. Potenza, R. Ricamo, and A. Rubbino (Università, Catania, Italy). Nucl. Phys., 41: 298-302(Mar. 1963). (In English)

The energy spectra of the charged particles produced in the (n,p) and (n,$\alpha$) reactions in silicon are analyzed using silicon detectors as targets. The excitation functions for the $Si^{28}(n,\alpha)$ transitions are given from 3.7 to 5.5 Mev. The observed fluctuations can hardly be attributed to single resonant states; it is suggested to interpret them as resulting mainly from fluctuations in the level density of the intermediate nuclei. (auth)

**19296** THE DECAY SCHEME OF $Yb^{166}$. A. Jasinski (Inst. for Nuclear Research, Polish Academy of Science, Swierk), J. Kownacki, H. Lancman, J. Ludziejewski, S. Chojnacki, and I. Yutlandov. Nucl. Phys., 41: 303-15 (Mar. 1963). (In English)

The gamma spectrum of $Yb^{166}$ is studied with a scintillation spectrometer. The probability $P_K$ of K-electron capture, the reduced half life for the decay to the excited state, and the conversion coefficient $\alpha_K$ of the 82 kev $\gamma$ transition are measured. The total decay energy is found to be 256 kev. The value of the reduced half life for the electron capture transition to the excited state has been established to be log ft = 4.60. The proposed decay scheme is discussed. (auth)

**19297** INVESTIGATION OF THE CROSS-SECTION OF NEUTRON REACTIONS IN THE NUCLEUS $Rh^{103}$. J. Csikai, J. Bacsó, and A. Daróczy (Inst. of Nuclear Research, Hungarian Academy of Sciences, Debrecen). Nucl. Phys., 41: 316-22(Mar. 1963). (In English)

For the reaction $Rh^{103}$ + n, the cross section $(\sigma_{n\gamma})$ ratio of reactions $Rh^{103}(n,\gamma)$ $Rh^{104,104m}$ at 0.032 ev, 24 kev, 116 kev, 2.49 Mev and 14.67 Mev neutron energies; $\sigma_{n\gamma}$ at 24 kev; the $\sigma_{n\gamma}/\sigma_{n\alpha}$ ratio at 2.49 Mev; and $\sigma_{n\gamma}$ and $\sigma_{n\alpha}$ at 14.67 Mev bombarding energies are determined. The presence of the reaction $Rh^{103}(n,\alpha)Tc^{100}$ is demonstrated. The half lives of the isotopes $Rh^{104}$, $Rh^{104m}$, and $Tc^{100}$ are measured. (auth)

**19298** RELATIVE NUCLEIDIC MASSES AND BINDING ENERGIES FOR $84 \leqq A \leqq 104$ AND $111 \leqq A \leqq 125$. V. A. Kravtsov (Kalinin Polytechnical Inst., Leningrad). Nucl. Phys., 41: 330-42(Mar. 1963). (In English)

Tables are presented that contain the nucleidic masses for $84 \leqq A \leqq 104$ and $111 \leqq A \leqq 125$, as well as nuclear total binding energies, nucleon separation energies, and pairing energies. The tables are intended to provide data on the strength of accurate experimental material. (auth)

**19299** DISTORTED WAVE ANALYSIS OF DEUTERON INDUCED REACTIONS IN $O^{18}$. J. R. Rook (Oxford Univ.). Nucl. Phys., 41: 343-5(Mar. 1963). (In English)

The distorted-wave Born approximation is used to analyze the reactions $O^{18}(d,t)O^{17}$ and $O^{18}(d,p)O^{19}$. Assignments of L values obtained from Butler theory are confirmed, fractional parentage coefficients are extracted,

and the wave function of the ground state of $O^{18}$ is estimated. (auth)

**19300** HALF-LIVES OF THE 67.7, 100 AND 222 kev TRANSITIONS IN $W^{182}$. E. Bashandy, M. S. El-Nesr, and S. C. Pancholi (Univ. of Uppsala). Nucl. Phys., 41: 346-52(Mar. 1963). (In English)

The half lives of the 67.7-, 100-, and 222-kev transitions in $W^{182}$ are determined by the delayed electron-electron coincidence technique. For energy selection a double magnetic long-lens beta spectrometer is used. It is found that the 100-kev E2 transition is enhanced by a factor of 116, while the 67.7- and 222-kev E1 transitions are retarded by $2.8 \times 10^3$ and $8.7 \times 10^5$ respectively, compared with the single-particle lifetime prediction. (auth)

**19301** EXCITATION FUNCTION FOR THE REACTION $C^{13}(\alpha,n\gamma)O^{16}$. R. H. Spear, J. D. Larson, and J. D. Pearson (California Inst. of Tech., Pasadena). Nucl. Phys., 41: 353-63(Mar. 1963). (In English)

The excitation function for 6 and 7 Mev gamma radiation from the reaction $C^{13}(\alpha,n\gamma)O^{16}$ was studied at intervals of approximately 10 kev for alpha particle energies from 5 to 10 Mev. Gamma rays were observed at 0 and 45° to the beam axis using a 10.2 cm × 10.2 cm NaI(Tl) crystal. The excitation function shows a complex structure; about 22 resonances were observed, corresponding to excited states of $O^{17}$ in the region of excitation from 10.4 to 13.7 Mev, with widths varying from approximately 10 kev to several hundred kev. Details of resonance energies and widths are presented, and the results compared with those from other experiments. (auth)

**19302** GAMMA-RADIATION FROM THE BOMBARDMENT OF CHLORINE, POTASSIUM AND CALCIUM NUCLEI WITH 150 Mev PROTONS. G. L. Salmon, K. J. Foley, and A. B. Clegg (Clarendon Lab., Oxford). Nucl. Phys., 41: 364-71(Mar. 1963). (In English)

Measurements are presented of gamma radiation produced in the bombardment of chlorine, potassium, and calcium nuclei with 150 Mev protons. Only a small number of gamma rays are produced strongly despite the large number of possible gamma rays in possible product nuclei. This is ascribed to the importance of simple direct reactions. (auth)

**19303** THERMAL NEUTRON ACTIVATION CROSS-SECTIONS FOR ISOMER PRODUCTION. [PART] II. S. K. Mangal and P. S. Gill (Muslim Univ., Aligarh, India). Nucl. Phys., 41: 372-9(Mar. 1963). (In English)

Thermal neutron activation cross sections were measured for the following cases: $Hg^{196}(n,\gamma)Hg^{197m}$, $Hg^{196}(n,\gamma)Hg^{197}$, $Pt^{194}(n,\gamma)Pt^{195m}$, $Pt^{192}(n,\gamma)Pt^{193m}$, $Os^{190}(n,\gamma)Os^{191m}$, $Os^{190}(n,\gamma)Os^{191}$, $Er^{170}(n,\gamma)Er^{171}$, $Pd^{110}(n,\gamma)Pd^{111m}$, $Gd^{158}(n,\gamma)Gd^{159}$, $Gd^{160}(n,\gamma)Gd^{161}$, $Ba^{134}(n,\gamma)Ba^{135m}$, $Ba^{132}(n,\gamma)Ba^{133m}$, $Sn^{122}(n,\gamma)Sn^{123}$, and $Sn^{124}(n,\gamma)Sn^{125}$. Using the spin distribution form due to Bethe and Block theoretically calculated isomeric ratios were compared with experimentally measured values. (auth)

**19304** FURTHER STUDIES ON THE DECAY OF $Eu^{156}$. B. V. Thosar, R. P. Sharma, and K. G. Prasad (Tata Inst. of Fundamental Research, Bombay). Nucl. Phys., 41: 380-7(Mar. 1963). (In English)

The beta decay of $Eu^{156}$ was studied by means of an intermediate image magnetic spectrometer modified for the beta-gamma coincidence studies. An attempt was made to detect the possible beta feeding to the lowest energy level of the beta vibrational band which is expected in the deformed $Gd^{156}$ nucleus. No definite indication of feeding of such a level in the decay of $Eu^{156}$ was detected and if it exists it should be less than 0.1%. The energy and intensity of different beta groups and various gamma rays in this decay are given. (auth)

**19305** MESIC ATOM EXPERIMENTS AND SHELL STRUCTURE. Walter Greiner and Florian Scheck (Universitat, Freiburg i. B.). Nucl. Phys., 41: 424-34(Mar. 1963). (In German)

An interpretation of some new measurements of the differences between the 2p-1s energies, of neighboring $\mu$-mesic atoms, i.e., atoms with nuclei ${}_ZX^A$ and ${}_{Z+1}X^{A'}$, is given by using the single-particle shell model for the (Z + 1)-th proton and the wave functions calculated by Ford and Wills for the $\mu$-meson. This interpretation makes possible a detailed discussion of the experimental data and, in particular, removes the disagreement between the experimental value for the Bi-Pb energy difference and the value calculated from electron scattering data by Ford and Wills. (auth)

**19306** (n,$\alpha$) REACTIONS ON LIGHT NUCLEI AT 14 Mev. B. Sen (Saha Inst. of Nuclear Physics, Calcutta). Nucl. Phys., 41: 435-8(Mar. 1963). (In English)

Angular distributions of alpha particles from (n,$\alpha$) reactions on light nuclei (carbon, nitrogen, and oxygen) were studied. The result shows that the pick-up and heavy particle stripping processes play a role in the reaction mechanism. (auth)

**19307** THE PARITY OF THE 4.97 Mev LEVEL IN $Ne^{20}$. H. E. Gove, A. E. Litherland, and M. A. Clark (Atomic Energy of Canada Ltd., Chalk River, Ont.). Nucl. Phys., 41: 448-60(Mar. 1963). (In English)

The parity of the level at 4.97 Mev in $Ne^{20}$ was determined to be negative by measuring the linear polarization of 3.34 Mev gamma rays emitted when this level decays to the first excited state of $Ne^{20}$ at 1.63 Mev. The level was excited by the reaction $Ne^{20}(p,p'\gamma)$ at an incident proton energy of 7.20 Mev. At this energy, the direct distribution of the 3.34 Mev gamma rays with respect to the proton beam was measured and was not isotropic. The linear polarization correlation was measured by the method of Compton scattering and this combined with the direct correlation established that the 4.97 Mev level had opposite parity to that of the 1.63 Mev state. Since the latter is positive, the parity of the 4.97 Mev level is negative. Previous experiments had shown that its spin is 2 and this combination of spin and parity excludes the 4.97 Mev level from participation in helium thermonuclear reactions. (auth)

**19308** THE DECAY SCHEME OF $Pb^{211}$. S. E. Vandenbosch, C. V. K. Baba, P. R. Christensen, O. B. Nielsen, and H. Nordby (Universitet, Copenhagen). Nucl. Phys., 41: 482-96(Mar. 1963). (In English)

The disintegration scheme of the 36.1 min $\beta^-$ emitter $Pb^{211}$ was studied by means of a six-gap $\beta$-ray spectrometer, scintillation spectrometers, coincidence techniques, directional correlation measurements, and lifetime measurements. The $\beta^-$ spectrum of $Pb^{211}$ has four components with endpoint energies: 1355 kev (92.4%), 951 kev (1.4%), 525 kev (5.5%), and 251 kev (0.7%). The following transitions in $Bi^{211}$ were observed: 404 kev (55% M1 and 45% E2), 426 kev (M1), 700 kev (M1), 830 kev (M1), and 1104 kev. A decay scheme is proposed with levels in $Bi^{211}$ at 0 kev ($\frac{9}{2}^-$), 404 kev ($\frac{7}{2}^-$), 830 kev ($\frac{9}{2}^-$), and 1104 kev. The transition energy between $Pb^{211}$ and $Bi^{211}$ is 1355 kev. The half life of the 404 kev level is $(3.15 \pm 0.20) \times 10^{-10}$ sec. The E2 lifetime of the 404 kev level is compared with theoretical estimates. The half life of the 830 kev level is less than $0.9 \times 10^{-10}$ sec. In addition it was possible to set an upper limit of $0.6 \times 10^{-10}$ sec on the half life of the 351 kev level

in $Tl^{207}$. The levels of $Bi^{211}$ are discussed in terms of single-proton states or states involving the single proton and two neutrons outside the doubly closed shell. (auth)

**19309** RADIOACTIVE DECAY OF $Ce^{143}$(33h). G. N. Rao and H. S. Hans (Muslim Univ., Aligarh, India). Nucl. Phys., 41: 511-19(Mar. 1963). (In English)

The gamma rays in the decay of $Ce^{143}$(33h) were studied with the help of a scintillation coincidence spectrometer. The relative branchings of the various gamma rays were estimated. By studying the $\gamma$-$\gamma$ coincidences the K-internal conversion coefficients of the 56, 230, and 293 kev transitions were determined to be 6.4 ± 0.6, 0.07, and 0.12 ± 0.02, respectively. The angular correlation measurements were performed for the 293-56 kev cascade. From these measurements, the spins of the ground, first, and the second excited states in $Pr^{143}$ were assigned to be $5/2^+$, $7/2^+$, and $2/2^+$, respectively. The 56 kev gamma ray was found to be a mixture of 99 ± 1% M1 and 1 ± 1% E2 and the 293 kev gamma ray a mixture of 97 ± 1% M1 and 3 ± 1% E2. (auth)

**19310** DECAY OF SCANDIUM 50. D. R. Koehler and W. L. Alford (Army Missile Command, Redstone Arsenal, Ala.). Nucl. Phys., 41: 520-3(Mar. 1963). (In English)

A study of the activities produced by 14 Mev neutron bombardment of titanium 50 is described. Evidence is found to support an assignment of levels in titanium 50 near 3.18, 2.67, and 1.56 Mev. Also reported are experiments that were unsuccessful in substantiating a 23 min isomeric level in $Sc^{50}$. (auth)

**19311** THE DECAY OF $Lu^{179}$. W. A. Stensland and A. F. Voigt (Ames Lab., Ames, Iowa). Nucl. Phys., 41: 524-8(Mar. 1963). (IS-552). (In English)

Sources of $Lu^{179}$ were prepared by the photo-proton reaction in isotopically enriched $Hf^{180}$. A value of 4.59 ± 0.06 h was found for the half life. Two beta branches were observed; 87 ± 3% of the decays go by a 1.35 ± 0.07 Mev beta ray to the ground state of $Hf^{179}$; 13 ± 3% go by a 1.08 ± 0.07 Mev beta ray to the 217 kev level in $Hf^{179}$. (auth)

**19312** THE CHARGE ASYMMETRY OF THE DEUTERON AND NUCLEAR STRIPPING REACTIONS. E. Coffou (Institute "Rudjer Bošković," Zagreb). Nucl. Phys., 41: 547-52(Mar. 1963). (In English)

The polarization of deuterons in the Coulomb field of the target nucleus is included in the stripping theory. An expression for the differential cross section is derived. The results are obtained by the plane-wave Born approximation under assumptions that lead to the Butler theory. (auth)

**19313** PROPERTIES OF SOME STATES IN $Dy^{160}$. F. Boehm and John Rohers (California Inst. of Tech., Pasadena). Nucl. Phys., 41: 553-60(Mar. 1963). (In English)

Using a bent-crystal gamma spectrometer the low energy transitions in the decay of $Tb^{160}$ into $Dy^{160}$ are investigated. Precise energies and relative intensities of 9 transitions are given. From this information, the hindrance factors for the transitions are extracted and some properties of the odd-parity states at 1264.4, 1286.5, 1358.3, and 1398.5 kev are discussed. Evidence is given for an even parity state at 1155.2 kev and an odd parity state at 1385.9 kev. (auth)

**19314** A PRECISE COMPARISON OF THE NEUTRON THRESHOLD ENERGY AND THE Q VALUE FOR THE $Li^7$(p,n)$Be^7$ REACTION. Frank C. Young and Jerry B. Marion (Univ. of Maryland, College Park). Nucl. Phys., 41: 561-74(Mar. 1963). (In English)

The Q value of the $Li^7$(p,n)$Be^7$ reaction is determined by measuring the angle of the cone of neutrons emitted in the forward direction at a proton energy 20 kev above the threshold energy. The proton energy is measured relative to the energy at which (neutron yield)$^{\frac{1}{2}}$ extrapolates to zero. The cone angle is determined by fitting the measured neutron yield at the edge of the cone with a calculated yield. With an energy spread of 240 ev in the proton beam and a detector resolution of 0.7°, the cone-angle is measured to an accuracy of 0.2°. If 1880.6 ± 0.3 kev is taken for the experimentally determined neutron threshold, the cone angle measurement gives Q = −1644.38 ± 0.17 kev relative to this energy point taken with no error. These measurements constitute a precise check on the validity of the kinematic equation for nuclear reaction dynamics. (auth)

**19315** ENERGY-LEVEL STRUCTURE OF $O^{19}$, $O^{18}$, AND $O^{17}$ INVESTIGATED BY (d,p) REACTIONS WITH 15 Mev DEUTERONS. Kohsuke Yagi, Yutaka Nakajima, Kenji Katori, Yohko Awaya, and Manabu Fujioka (Tokyo Univ.). Nucl. Phys., 41: 584-603(Mar. 1963). (In English)

The reactions $O^{18}$(d,p)$O^{19}$, $O^{17}$(d,p)$O^{18}$, and $O^{16}$(d,p)$O^{17}$ are studied with 14.95-Mev deuterons and a broad-range magnetic spectrograph. Absolute cross sections are measured. Angular distributions are analyzed with the Butler-Born theory to determine reduced widths. In $O^{18}$(d,p)$O^{19}$ reactions, energies (Mev), $l_n$, and $J^\pi$ of $O^{19}$ levels obtained are as follows: 0, 2, $5/2^+$; 0.096, (2), $3/2^+$; 1.468, 0, $1/2^+$; (2.612); 3.171, 1; 3.942; 4.111, (1); 5.153; 5.447, 2, $3/2^+$; (5.708); 6.282, 3, $7/2^-$; (6.480); (6.560); (6.899); 6.997; (7.117); and 7.248. Assignments in parenthesis are not definitely established. From $O^{17}$(d,p)$O^{18}$ reactions; 4.440, 1, $(3)^-$; 5.092; (5.375); 5.492; and 6.200 are obtained. In $O^{16}$(d,p)$O^{17}$ reactions, intense transitions with $l_n$ = 2 to the ground $1d_{5/2}$ and 5.083-Mev $1d_{3/2}$ states and with $l_n$ = 0 to 0.871-Mev 2s state are observed, giving 1d and 2s single-particle reduced widths. A strong $l_n$ = 3 transition proceeds to 5.697 Mev ($J^\pi = 7/2^-$) level, while the transition intensity for the lower $7/2^-$ (3.846 Mev) level is 0.18 times as weak. In $O^{18}$(d,p)$O^{19}$ reactions, the single-particle character of four strongly excited levels of $O^{19}$ and their correspondence to those of $O^{17}$ are discussed. An estimate is made of the configuration admixtures in the $O^{18}$ ground state taking into account $O^{18}$(d,t)$O^{17}$ reaction data. The presence of 24 ± 6% $(1f_{5/2}^2)_0$ component (in intensity) is concluded. The experimentally determined admixtures are compared with shell-model calculations. The measured spectroscopic factors for the transitions to the three lowest levels of $O^{19}$ can be interpreted with shell-model wave functions of these states and of the $O^{18}$ ground state. (auth)

**19316** THE HALF-LIVES OF $Tl^{204}$, $Au^{195}$, $Ir^{192}$, AND ITS LONG-LIVED ISOMER $Ir^{192m}$. Garman Harbottle (Brookhaven National Lab., Upton, N. Y.). Nucl. Phys., 41: 604-7(Mar. 1963). (BNL-6457) (In English)

The measured half lives of several nuclides are $Tl^{204}$ (3.80 ± 0.02) yr, $Au^{195}$(182.9 ± 0.5) days, $Ir^{192}$(73.6 ± 0.4) days, and $Ir^{192m}$(650 ± 430 or −90) yr. The periods of measurement are 12.0, 3.3, 3.3, and 3.1 yr respectively. The reactor cross section for the reaction $Ir^{191}(n,\gamma)Ir^{192m}$ is estimated as 0.38 + 0.24 or −0.11 b. (auth)

**19317** STUDY OF THE DECAY OF $F^{21}$. P. Kienle and K. Wien (Technische Hochschule, Munich). Nucl. Phys., 41: 608-13(Mar. 1963). (In German)

$F^{21}$ is produced by the $F^{19}$(t,p)$F^{21}$ reaction. It is shown conclusively that $F^{21}$ decays by $\beta$-branches to the 0.345- and 1.73-Mev states of $Ne^{21}$ with a half life of 4.6 ± 0.3 sec. A decay scheme including spin assignments of the ground state of $F^{21}$ ($5/2^+$) and the 0.345-Mev ($5/2^+$) and the 1.73-Mev ($7/2^+$) states of $Ne^{21}$ is proposed. (auth)

**19318** RESONANCE PARAMETERS OF THE NEUTRON CROSS SECTION OF $U^{238}$. F. W. K. Firk, J. E. Lynn, and M. C. Moxon (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Nucl. Phys., 41: 614-29(Mar. 1963) (In English)

The Harwell 15 Mev electron linear accelerator is used to measure the neutron transmission of $U^{238}$ up to a neutron energy of 2 kev with a neutron time-of-flight resolution of 2.5 nsec • $m^{-1}$. Neutron resonance parameters of 100 resonances are determined using an area method of analysis of the transmission data. A value for the neutron strength function $\overline{\Gamma_n^0}/\overline{D} = (1.00 \pm 0.14) \times 10^{-4}$ is obtained. The total radiation widths $\Gamma_\gamma$ of three resonances are determined; the mean value is 27.6 ± 1.3 mev. The reduced neutron widths $\Gamma_n^0$ are found to fluctuate in a manner compatible with a distribution of the chi-squared family with "number of degrees of freedom" $\nu$ equal to 1.02 ± 0.12. The distribution of level spacings is well described by the Wigner simple level repulsion formula. (auth)

**19319** THE RADIAL DISTRIBUTION OF THE IMAGINARY PART OF THE NUCLEAR OPTICAL POTENTIAL AT LOW ENERGIES. M. Z. Rahman Khan (Muslim Univ., Aligarh, India). Nucl. Phys., 41: 629-39(Mar. 1963). (In English)

The radial distribution of the imaginary part of the nuclear optical potential at low energies is studied. A general idea of the determination of the radial distribution from phenomenological analysis is obtained by making use of a distorted wave approximation, which treats the departure of the imaginary part of the potential from a uniform distribution as a perturbation. The study leads to the conclusion that S-wave strength function data are the most important means of determining the radial distribution at low energies. The results, obtained after performing exact numerical calculations, indicate that at low energies the imaginary part of the potential is distributed mostly in the surface region. Another significant point emerging from the numerical calculations is that the center of the imaginary distribution (which is taken to be a Gaussian) lies about 1 fermi outside the half-way radius of the real part of the potential. (auth)

**19320** RELATIVE INTENSITIES OF 860 TO 2130 kev $Ir^{194}$ γ-LINES. V. D. Vitman, N. A. Voinova, and B. S. Dzelepov (Mendeleyev Metrology Research Inst., USSR and Leningrad Inst. of Physics and Tech.). Nucl. Phys., 41: 669-74(Mar. 1963). (In English)

The γ spectrum of $Ir^{194}$ is investigated with a γ spectrometer using magnetic analysis of recoil electrons. γ line hν = 1569 kev is detected. Relative intensities of 23 γ lines are determined. Multipolarities are given for some transitions. (auth)

**19321** APPLICATION OF A ROTATIONAL MODEL TO $Li^7$. Coral M. Chesterfield and B. M. Spicer (Univ. of Melbourne). Nucl. Phys., 41: 675-89(Mar. 1963). (In English)

The properties of $Li^7$ are described on the basis of a strong-coupling rotational model. Comparisons of the predictions of this model are made with the known properties of the $Li^7$ nucleus: the energy-level spectrum; the ground state magnetic dipole and electric quadrupole moments; lifetime of the first excited state; Coulomb excitation probability of the first excited state; and deuteron stripping and proton inelastic scattering reactions leading to excited states of $Li^7$. Quantitative agreement is obtained. (auth)

**19322** ON THE MEASUREMENT OF MOMENTUM TRANSFER IN NUCLEAR INTERACTIONS. C. M. Fisher, W. M. Gibson, A. Mason, and W. A. Venus (Univ. of Bristol, Eng.). Nuovo Cimento (10), 27: 761-8(Feb. 16, 1963). (In English)

It is shown that a lower limit for the momentum transferred to the target nucleus by an incident fast charged particle may be obtained by measuring the directions of the emitted particles, without measuring individual momenta. In cases with no unseen neutral particles, and negligible energy transfer, a value of the longitudinal momentum transfer may also be obtained. A technique is developed that is useful in distinguishing processes involving small momentum transfer, such as Coulomb and diffraction dissociation. (auth)

**19323** AN EXAMPLE OF $^7Be_\Lambda$ DECAYING BY $\pi^-$ EMISSION. R. G. Ammar, M. Holland, J. H. Roberts, and E. N. Shipley (Northwestern Univ., Evanston, Ill.). Nuovo Cimento (10), 27: 769-73(Feb. 16, 1963). (In English)

A uniquely identified example of the decay of $_\Lambda Be^7$ is presented. The mere fact that this species can exist has consequences relating to the multiplet structure of the mass-number-7 hypernuclei. The average binding obtained from this event is $B_\Lambda = (4.9 \pm 0.5)$ Mev. (auth)

**19324** AN EXAMPLE OF HYPERFRAGMENT DECAY IN THE $\pi^+$ MODE AND OTHER INTERACTIONS OF $K^-$ MESONS AND HYPERONS IN EMULSION. Marietta Blau (Inst. for Radium Research, Vienna), C. F. Carter, and A. Perlmutter. Nuovo Cimento (10), 27: 774-85(Feb. 16, 1963). (In English)

A number of interactions of hyperons and $K^-$ mesons with emulsion nuclei are described. In particular, an example of a hyperfragment decaying by the $\pi^+$ mode and a possible $(\Sigma^+ p)$ hyperfragment decay are observed. Also described are captures of $\Sigma^-$ hyperons with large energy release, an unusual $\Sigma^-$ decay, a possible example of $\Sigma^+ \rightarrow p + \gamma$, and certain $K^-$-multi-nucleon interactions. A summary of $\Sigma^+$ inelastic interactions with nuclei is also included. (auth)

**19325** THE ELECTRON-NEUTRINO ANGULAR CORRELATION IN β-DECAY OF $^{91}Y$. C. Manduchi, M. T. Russo-Manduchi, and G. Tornielli (Università, Padua and Istituto Nazionale di Fisica Nucleare, Padua). Nuovo Cimento (10), 27: 786-90(Feb. 16, 1963). (In English)

The ratio of transition probabilities corresponding to forward and backward correlation in the unique first-forbidden β decay of $Y^{91}$ is experimentally determined from measurements of the distribution of β energy and recoil time-of-flight. It may be deduced that the interaction that controls the main β decay is predominantly of the axial vector type. (auth)

**19326** STUDIES ON MULTIPLE COULOMB SCATTERING IN NUCLEAR EMULSIONS. Yash Pal and A. K. Ray (Tata Inst. of Fundamental Research, Bombay). Nuovo Cimento (10), 27: 960-76(Feb. 16, 1963). (In English)

Properties of spurious scattering are studied in a variety of emulsion stacks exposed to high-energy particle beams. Spurious scattering, found with different magnitudes in different regions of the same stack, is characterized by a parameter, $q_s$, which is independent of cell size. Variation of the spurious scattering signal with cell size is investigated, and a procedure for measuring momenta in the presence of spurious scattering is demonstrated. The scattering constant is measured as a function of cell length; it is found that its value decreases for cell sizes larger than 8 mm. (auth)

**19327** FERMI SYSTEM OF HARD SPHERES. G. W. Bund and W. Wajntal (Instituto de Física Teórica, São

Paulo, Brazil). Nuovo Cimento (10), 27: 1019-24(Feb. 16, 1963). (In English)

Particle-particle and hole-hole interactions in low-density infinite systems of hard-core fermions are studied. Parameters of the system are expanded in powers of $p_F c$, where $p_F$ is the Fermi momentum and c is the core radius. Results are found up to third order in $p_F c$, and results for $p_F c = 0.6$ (the value in nuclear matter) are given as examples. (T.F.H.)

**19328** MUON CAPTURE IN HYDROGEN. A. Fujii (CNEN, Rome). Nuovo Cimento (10), 27: 1025-31(Feb. 16, 1963). (In English)

The rate of the reaction $\mu^- + p \rightarrow n + \nu$ is calculated within the framework of the universal V – A theory, and this value is compared with the experimental $\mu^-$ capture rate in liquid $H_2$. The theoretical predictions all fall higher than the experimental values. Reasons for this discrepancy are discussed. (T.F.H.)

**19329** SOFT GAMMA-RAYS FROM THERMAL NEUTRON CAPTURE IN Tb, Er, Yb AND Ta. [PART] II. M. Giannini, D. Prosperi, and S. Sciuti (CNEN, Rome and Università, Rome). Nuovo Cimento (10), 27: 1032-6 (Feb. 16, 1963). (In English)

The gamma energies and intensities of $Tb^{160}$, $Ta^{182}$, $Er^{168}$, $Yb^{169}$, and $Yb^{175}$, produced by thermal-neutron capture in natural targets of these elements, are measured at 40 to 280 kev. (T.F.H.)

**19330** CHARGE SUPERSELECTION ARISING FROM RANDOM ELECTROMAGNETIC INTERACTIONS. E. Fabri and G. Fiorio (Università, Pisa, Italy and Istituto Nazionale di Fisica Nucleare, Pisa, Italy). Nuovo Cimento (10), 27: 1037-8(Feb. 16, 1963). (In English)

A quantum calculation is presented, based on the idea that charge fluctuations increasing with time are responsible for the "charge superselection" rule observed in all experiments, which shows the lower limits for the validity of charge superselection. Conditions are discussed under which charge superselection might be observed to break down. (T.F.H.)

**19331** A STUDY OF $K^-$-MESIC ATOMS. A. D. Martin (University Coll., London). Nuovo Cimento (10), 27: 1359-78(Mar. 16, 1963). (In English)

An investigation is made of the atomic capture of $K^-$ mesons by the atoms of nuclear emulsion. The initial population of the mesic capture states is estimated; from this population distribution a detailed cascade calculation is performed. The energy spectrum of the Auger electrons ejected during the de-excitation of the mesic atom is given, and the intensities of certain x-ray lines are shown to be dependent on the properties of the nuclear surface. The probabilities of nuclear capture of the meson from the various mesic states are found, and the probability that a $\Lambda^0$ hyperon, produced as a result of this nuclear capture, is trapped within the nucleus is determined. Similar calculations for $\Sigma^-$ hyperic atoms are also included. (auth)

**19332** BINDING ENERGY OF VERY HEAVY HYPERFRAGMENTS. J. Cuevas (Institut fur Experimentalphysik, Hamburg), J. Diaz, D. Harmsen, W. Just, H. Kramer, H. Spitzer, M. W. Teucher, and E. Lohrmann. Nuovo Cimento (10), 27: 1500-2(Mar. 16, 1963). (In English)

The detection of 4 hypernuclei with probable mass numbers between 50 and 80 is reported. Upper limits of the Λ-hyperon binding energies for these hypernuclei are found to be 21.1 to 30.1 Mev. (T.F.H.)

**19333** FOUNDATIONS OF THE NUCLEAR SHELL MODEL. B. H. Brandow (Cornell Univ., Ithaca, N. Y.). Phys. Letters, 4: 8-11(Mar. 1, 1963). (In English)

A derivation of the nuclear shell model is given. A closed-shell nucleus without degeneracy is considered to invalidate the Gladstone expansion. The two-body effective potential depends not only on the local density and the local relative momentum but on the energies of the interacting nucleons and on the local analog of the total momentum of the pair. The single-particle energies are not equal to the removal energies. (C.E.S.)

**19334** IS THE BETA DECAY OF $Pr^{144}$ A $1^- \rightarrow 0^+$ TRANSITION? B. Eman (Inst. Rudjer Bošković, Zagreb) and D. Tadić. Phys. Letters, 4: 13-14(Mar. 1, 1963). (In English)

The beta decay of $Pr^{144}$ is analysed under the assumption that the ground state is $1^-$ contrary to the usual opinion that the $\beta^-$ transition $Pr^{144}$–$Nd^{144}$ is the $0^- \rightarrow 0^+$ type. The analysis leads to the conclusion that the $\beta$ spectrum and the longitudinal polarization measurements are consistent with the assignment $1^-$ for the ground state of $Pr^{144}$. If this assignment is correct, this decay can be used to test the conserved vector current hypothesis. (C.E.S.)

**19335** EXCITED-CORE MODEL OF ODD-A NUCLEI AND THE $Cu^{63}(p,p')$ REACTIONS. F. Perey, R. J. Silva, and G. R. Satchler (Oak Ridge National Lab., Tenn.). Phys. Letters, 4: 25-7(Mar. 1, 1963). (In English)

To test the predictions of the excited-core model of odd-A nuclei, measurements were made of the inelastic scattering of 11-Mev protons from $Cu^{63}$ and $Ni^{62}$. The 11-Mev proton beam of the ORNL tandem Van de Graaff was scattered from 1 mg/cm$^2$ enriched targets of $Cu^{63}$ and $Ni^{62}$. The results were in good agreement with predictions. (C.E.S.)

**19336** THE FORWARD-BACKWARD ASYMMETRY OF RECOIL NUCLEI IN THE REACTION $Al^{27}(n,\alpha)Na^{24}$. J. Csikai, B. Gyarmati, I. Hunyadi, and J. Németh (Inst. of Nuclear Research, Hungarian Academy of Sciences, Debrecen). Phys. Letters, 4: 33(Mar. 1, 1963). (In English)

The forward-backward asymmetry of recoil nuclei from the reaction $Al^{27}(n,\alpha)Na^{24}$ was investigated by the recoil technique. On polyethylene foils placed in forward (F) and backward (B) directions, the recoil nuclei emitted into intervals $0_B - \pi/2$ and $\pi/2 - \pi$, respectively, were captured. The $\beta$-activity ratio of the $Na^{24}$ upon the forward and backward foils ($A_F/A_B$) was measured as a function of the thickness of the aluminum foil and extrapolated to 0-thickness. The value 5.1 ± 0.3 was obtained. (C.E.S.)

**19337** NUCLEAR MAGNETIC PROPERTIES OF ADSORBED $He^3$. G. Careri, M. Giura, and M. Santini (Università, Rome). Phys. Letters, 4: 61-2(Mar. 1, 1963). (In English)

The temperature dependence of the nuclear magnetization of a monolayer of $He^3$ adsorbed on zeolite was measured by the technique of nuclear resonance at liquid helium temperatures. The nuclear magnetization did not follow the Curie law but exhibited a behavior that resembles the curve of spontaneous magnetization of ferromagnetics below the Curie temperature. (C.E.S.)

**19338** ASYMMETRY PARAMETER OF NEUTRONS AND TRITONS FROM THE CAPTURE OF POLARISED $\mu^-$ IN $^4He$. A. Bietti (Università, Rome and Instituto Nazionale di Fisica Nucleare, Rome). Phys. Letters, 4: 63-4(Mar. 1, 1963). (In English)

The asymmetry parameters of the recoil nuclei and the emitted neutrons were measured for polarized mesons($\mu$) capture by spin zero nuclei, in $\mu^- + He^4 \rightarrow H^3 + n + \nu$. The triton and neutron spectra give information about the coupling constants of the process, the pseudoscalar term, and the weak magnetism term. (C.E.S.)

**19339** EXCITATION FUNCTIONS FOR SINGLE-NUCLEON TRANSFER REACTIONS CLOSE TO THE BARRIER. K. S. Toth and E. Newman (Oak Ridge National Lab., Tenn.). Phys. Rev., 130: 536-40(Apr. 15, 1963).

Thick targets of KI, RbCl, ZnS, and Al were bombarded with 27.5-Mev $N^{14}$ ions, and excitation functions were obtained for the following single-nucleon transfer reactions: $K^{39}(N^{14},O^{15})Ar^{38}$; $Cl^{35}(N^{14},O^{15})S^{34}$; $Cl^{35}(N^{14},N^{15})Cl^{34m}$; $S^{32}(N^{14},O^{15})P^{31}$; and $Al^{27}(N^{14},O^{15})Mg^{26}$. The proton transfer reactions were identified by the annihilation radiation from the $O^{15}$ (2.1 min) positrons; the neutron transfer reaction was identified by the characteristic 145-kev $\gamma$ ray of $Cl^{34m}$ (32.4 min). The cross sections at 27.0 Mev (lab) were found to be 0.35, 1.35, 0.73, 1.55, and 0.45 mb respectively. Single-nucleon transfer excitation functions at low bombarding energies were accumulated and examined from the standpoint of the tunneling theory. It was found that reactions involving the targets $B^{10}$ and $N^{14}$ invariably behaved anomalously. Explanations of this behavior were offered. The ratios of reduced widths for the transferring neutron in $N^{14}$ and $F^{19}$ were determined from four pairs of reactions. These four ratios, which should have been identical, agreed to within a factor of 3. The "universal curve" noted for transfer reactions was found to be invalid when all the data were considered. (auth)

**19340** EXCITATION OF Ne, Ar, AND Kr INDUCED BY $H^+$ AND $He^+$ IMPACT (5-35 kev). J. van Eck, F. J. de Heer, and J. Kistemaker (F.O.M.-Lab. for Mass Separation, Amsterdam). Phys. Rev., 130: 656-8(Apr. 15, 1963).

Impact radiation from $H^+$ and $He^+$ in noble gases is studied in the wavelength region below 1250 Å. A vacuum spectrograph is calibrated for this purpose, so that the measurements provide absolute excitation or emission cross sections. Strong maxima are observed in the light intensities of some atom and ion lines of noble gases. These maxima appear at remarkably low energies of the impinging particles, and moreover, correspond with large absolute cross sections ($\sim 10^{-17}$ $cm^2$/atom). For instance, the excitation of the $np^6\ ^2S_{\frac{1}{2}}$ states of Ar II (n = 3) and Kr II (n = 4) induced by the $He^+$ impact on Ar and Kr show maxima at 9 and 7 kev, respectively. This observation can be predicted by the adiabatic criterion. However, for the $(n + 1)s'\ ^2D_{\frac{3}{2}}$ states of Ar II (n = 3) and Kr II (n = 4) the maxima lie below 5 kev, though more energy is needed for the excitation of these states than for the $^2S_{\frac{1}{2}}$ ones. Also for the excitation of the $2p^5$ 3s state of Ne I induced by $He^+$ impact on Ne, the maximum lies below 5 kev. There are indications that intermediate molecular states occur that contribute to the formation of these low-energy maxima. (auth)

**19341** MODEL FOR THE SCATTERING OF SLOW ELECTRONS BY CESIUM ATOMS. W. R. Garrett and R. A. Mann (Univ. of Alabama, University). Phys. Rev., 130: 658-60(Apr. 15, 1963).

The computation of the total cross section for the elastic scattering of slow electrons from cesium atoms was investigated. The model adopted consisted of a combination of a given polarization potential with the Hartree potential of a cesium atom. The cross section was computed by the phase-shift method. Using the reported values of the polarizability of cesium and a value of 6.13 $a_0$ for the cutoff parameter, $fr_0$, in the polarization potential, it was found that this model gave values of the cross section in agreement with experimental results. A method was proposed for the choice of the cutoff parameter. (auth)

**19342** CALCULATION OF ELASTIC AND INELASTIC PROTON SCATTERING WITH A GENERALIZED OPTICAL MODEL. B. Buck (Oak Ridge National Lab., Tenn.). Phys. Rev., 130: 712-26(Apr. 15, 1963).

An extension of the optical model is considered in which a state of quadrupole collective motion is strongly coupled to the nuclear ground state. The calculations include a spin-orbit potential and the simultaneous coupled differential equations of the problem are solved numerically on a high-speed computer. Experimental data on the scattering of medium energy protons from Ti, Cr, Fe, Ni, and Zn are analyzed. A good average optical potential is determined and conclusions are drawn about the energy dependence of the parameters. Evidence is presented for the validity of the collective model. Nuclear deformabilities derived by fitting the inelastic differential cross sections are in agreement with those determined by electromagnetic methods. Various limitations and ambiguities of the model are discussed and possible improvements are indicated. (auth)

**19343** HALF LIVES OF THE FIRST EXCITED STATES IN $Sn^{117}$, $Te^{121}$, $Te^{123}$, AND $Sb^{123}$. M. Schmorak, A. C. Li, and A. Schwarzschild (Brookhaven National Lab., Upton, N. Y.). Phys. Rev., 130: 727-30(Apr. 15, 1963). (BNL-6555)

Half lives of the first excited states of $Sn^{117}$ [161 kev, (0.31 ± 0.03) nsec], $Te^{121}$ [214 kev, (0.062 ± 0.015) nsec], $Te^{123}$ [159 kev, (0.186 ± 0.020) nsec], and $Sb^{123}$ [161 kev, (0.64 ± 0.05) nsec] were measured by the delayed coincidence method. The transitions were predominantly M1, retarded by a factor between 30 and 140 relative to the Weisskopf estimate. The E2 speeds of these transitions were also inferred, and varied from 0.1 to 30 times single-particle speed. (auth)

**19344** (n,2n) REACTION CROSS SECTIONS FROM 12 TO 19.6 Mev. L. A. Rayburn (Argonne National Lab., Ill. and Univ. of Georgia, Athens). Phys. Rev., 130: 731-4 (Apr. 15, 1963). (TID-17639)

Cross sections for the $Cu^{63}(n,2n)Cu^{62}$, $Zn^{64}(n,2n)Zn^{63}$, $Ag^{107}(n,2n)Ag^{106}$ ($T_{\frac{1}{2}}$ = 24 min), and $Sb^{121}(n,2n)Sb^{120}$ ($T_{\frac{1}{2}}$ = 16 min) reactions were measured at incident-neutron energies between 12 and 19.6 Mev. These cross sections were determined relative to the cross section for the $Cu^{63}(n,2n)Cu^{62}$ reaction at an incident-neutron energy of 14.4 Mev. The relative cross sections were expressed as absolute cross sections by using a value of 503 mb ± 7.3% for the cross section of the $Cu^{63}(n,2n)Cu^{62}$ reaction at 14.4 Mev. Some of the data were compared with the predictions of the compound-nucleus model. (auth)

**19345** EVALUATION OF THE VAN HOVE CORRELATION FUNCTIONS FOR CERTAIN PHYSICAL SYSTEMS. Roger B. De Bar (Stanford Univ., Calif.). Phys. Rev., 130: 827-32(Apr. 15, 1963).

The space and time Fourier transforms of the Van Hove correlation function are evaluated for the cases of coherent scattering from simple crystals and, in a "quantum hydrodynamics" approximation, from liquid He II. A compact approximate expression for the one-phonon part of the crystal correlation function transform is given, and the contribution of the two-phonon term is considered. A method of obtaining quantum-mechanical corrections to the classical expression for the Van Hove self-correlation function is discussed. (auth)

**19346** NEW METHODS IN NUCLEAR STRUCTURE CALCULATIONS. M. K. Banerjee and C. A. Levinson (Princeton Univ., N. J.). Phys. Rev., 130: 1036-63(May 1, 1963). (PUC-1961-47)

Methods for evaluating shell-model matrix elements in the SU3 classification scheme of Elliott are given. There

are no restrictions on the number of particles. The relationship of the SU3 coupling scheme to the model of a rotating asymmetric nucleus is investigated in detail. (auth)

**19347** CALCULATIONS OF ENERGY SPECTRA OF NUCLEI IN THE 2s, 1d SHELL. M. K. Banerjee, C. A. Levinson, and S. Meshkov (Princeton Univ., N. J.). Phys. Rev., 130: 1064-8(May 1, 1963). (PUC-1962-84)

Using the shell-model classification scheme based on the group SU3, the energy spectrum of $Mg^{24}$ is studied in detail. Using only the lowest SU3 state it is not possible to obtain a good fit to the experimental data. A variational method is introduced within the framework of the SU3 scheme that admixes higher states. This yields good agreement between theory and experiment. (auth)

**19348** MONOENERGETIC POSITRON LINE AND THREE NEW GAMMA TRANSITIONS IN $Bi^{208}$. R. Wiener, C. Chasman, P. Harihar, and C. S. Wu (Columbia Univ., New York). Phys. Rev., 130: 1069-77(May 1, 1963).

The monoenergetic positron line (the 1.72-Mev transition) in $Bi^{208}$ was sought using an intense $Bi^{208}$ source in a two-cycle baffled solenoid spectrometer. The source was prepared by bombarding in a deuteron beam a highly purified radiogenic lead target with $Pb^{206}$ isotopic content enriched from 26 to 87.7%. The comparative $Bi^{205}$ contamination is thus reduced to less than 0.05%. The leak through of the opposite sign of particles of the baffle used is better than 1 in $10^7$. A small peak of ~1% above the base line is observed at the predicted momentum value for the monoenergetic positron line (3970 Gcm). The intensity of the positron line is estimated to be $3.2 \times 10^{-8}$ per gamma ray, which is one-sixth of that first reported by Brunner. The retardation factor of this E1 (1.720 Mev) transition is estimated to be around 600. Three new gamma-transitions above the highest energy line (1.720 Mev) known previously were found and identified. These are 1.845, 1.88, and 1.90 Mev. From the ratios of internal conversion to internal pair production, one can assign E1 to both 1.845 and 1.880-Mev transitions. The 1.90-Mev transition is probably also of the E1 type. (auth)

**19349** (p,γ) RESONANCE-CURVE SHAPES AND MEASUREMENTS OF RESONANCE ENERGIES WITH $H_1^+$ BEAMS. R. O. Bondelid and J. W. Butler (Naval Research Lab., Washington, D. C.). Phys. Rev., 130: 1078-90(May 1, 1963).

During the preparation of a new precise absolute energy scale for nuclear reaction accelerators, some anomalies were observed in the behavior of (p,γ) resonances. These observations led to an exhaustive investigation of (p,γ) yield-curve shapes and detailed interpretation of these shapes in terms of physically significant quantities such as resonance energy and resonance width. Most of the measurements were made with respect to the 992-kev resonance in the $Al^{27}(p,\gamma)$ reaction, but other reactions were also used. A list of the anomalies observed includes (1) the failure of the peaks of thin-target resonance yield curves to be shifted from resonance energy by as much as half the target thickness, (2) the displacement of the midpoint of the rise of thick-target yield curves to bombarding energies below the resonance energy, (3) the overshoot of the yield curve for thick targets forming a hump above the thick-target plateau, (4) the obtaining of apparently different intrinsic resonance widths for the same resonance and from the same thick target at different times separated by a few weeks, and (5) the obtaining of significantly different thick-target yield-curve shapes from the same target in two different orientations with respect to the beam. The anomalies are all satisfactorily explained on the basis of fluctuations in energy loss of the bombarding protons as they penetrate the target. The theory used was chiefly developed by Symon. Detailed numerical integrations of the formal yield equation were made, and in most cases very good fits were made with the experimental data. The information gained from this investigation is applied to energy calibrations resulting in precise best values for the following narrow (p,γ) resonances: $Al^{27}(p,\gamma)Si^{28}$ reaction, 991.91 ± 0.30 and 1317.19 ± 0.40 kev; $C^{13}(p,\gamma)N^{14}$ reaction, 1747.06 ± 0.53 kev; $Ni^{58}(p,\gamma)Ni^{59}(p,\gamma)Cu^{59}$ reaction, 1423.64 ± 0.43 and 1843.45 ± 0.56 kev. The displacement of the midpoint of the rise of a thick-target yield curve from the resonance energy $E_r$ as a function of the resonance width Γ is discussed, and a typical curve of this relation is shown. The overshoot or hump height for a thick target as a function of Γ is also discussed, and a curve is shown. (auth)

**19350** CALCULATION OF THE BINDING ENERGY OF NUCLEAR MATTER BY THE METHOD OF REFERENCE SPECTRUM. M. Razavy (Cornell Univ., Ithaca, N. Y.). Phys. Rev., 130: 1091-9(May 1, 1963).

The binding energy of nuclear matter was calculated with the Hamada-Johnson potential by the method of the reference spectrum of Bethe et al. Corrections due to the exclusion principle, difference of spectrums, and the motion of the center of mass were not included, these are believed to be small. It is found that the binding energy is only −7.8 Mev per particle at a density corresponding to the Fermi momentum $k_F = 1.12F^{-1}$. This result is similar to the result of the calculations by Brueckner and Masterson with the Breit potential. A discussion of the self-consistency of the method is given. (auth)

**19351** PSEUDOQUADRUPOLE COUPLING CONSTANTS AND NUCLEAR MOMENTS OF SEVERAL PROMETHIUM ISOTOPES. R. W. Grant and D. A. Shirley (Univ. of California, Berkeley). Phys. Rev., 130: 1100-8(May 1, 1963). (UCRL-10472)

Nuclei of several isotopes of promethium were aligned at low temperatures by a pseudoquadrupole interaction in cerium magnesium nitrate and by a magnetic hfs interaction in neodymium ethylsulfate. Pseudoquadrupole coupling constants were determined for $Pm^{143}$, $Pm^{144}$, and 5.4-day $Pm^{148}$. Nuclear moments were derived for $Pm^{143}$, 5.4-day $Pm^{148}$, 41-day $Pm^{148}$, and $Pm^{149}$. The spins of 5.4-day and 41-day $Pm^{148}$ were found to be 1 and 6, respectively. Evidence was obtained for spin assignments of 6 to states in $Sm^{148}$ at 1.90, 2.09, and 2.19 Mev. Measurements on $Pm^{144}$ tend to confirm the validity of the temperature scale for cerium magnesium nitrate. (auth)

**19352** SCATTERING OF $He^3$ FROM $He^3$. T. A. Tombrello and A. D. Bacher (California Inst. of Tech., Pasadena). Phys. Rev., 130: 1108-11(May 1, 1963).

The elastic scattering of $He^3$ particles from a $He^3$ target was investigated for bombarding energies between 3 and 12 Mev. Excitation curves were obtained for center-of-mass scattering angles 30.6°, 54.8°, 70.1°, and 90°; and angular distributions were measured at bombarding energies of 3.03, 5.90, 7.91, 9.92, and 11.93 Mev. The excitation curves are without structure and all decrease with increasing energy in a smooth, monotonic fashion. The five angular distributions exhibit marked disagreement with theoretical predictions based on the resonating group structure method. (auth)

**19353** SCATTERING OF $He^3$ FROM $He^4$. T. A. Tombrello and P. D. Parker (California Inst. of Tech., Pasadena). Phys. Rev., 130: 1112-19(May 1, 1963).

Doubly-charged $He^3$ ions were scattered from helium gas to permit the investigation of excited states in $Be^7$ at exci-

tation energies between 3.9 and 8.4 Mev. In addition to the known $^7/_2^-$ level at 4.54 Mev, the $^5/_2^-$ member of this l = 3 spin-orbit doublet was also observed. This new state is located at an excitation energy of 6.51 ± 0.04 Mev and has a reduced width of $3.96 \times 10^{-13}$ Mev cm. No positive-parity states are observed in this range of excitation energies. A phase-shift analysis of the data was made for bombarding energies above 5.75 Mev, and the spin polarization of the scattered particles was calculated. Several regions in the $\theta_{c.m.}$, $E_{He^3}$ plane were found that should yield polarizations near unity. (auth)

**19354** EMISSION OF $Li^8$, Be, AND B FRAGMENTS FROM NUCLEI IN PHOTOGRAPHIC EMULSION. F. O. Breivik, T. Jacobsen, and S. O. Soerensen (Univ. of Oslo). Phys. Rev., 130: 1119-26(May 1, 1963).

A method of identification of tracks of heavy fragments emitted from highly excited nuclei in photographic emulsions exposed to 4.5-Bev mesons ($\pi^-$) is described. Charge spectra, energy spectra, angular distributions, etc., of the fragments are determined. An argument is presented for an isotropic emission of the fragments in the system of the moving parent Ag- or Br-nucleus. (auth)

**19355** LIFETIMES OF THE FIRST EXCITED STATES OF $Mg^{25}$ AND $Al^{25}$. C. L. McClelland and J. Lowe (Brookhaven National Lab., Upton, N. Y.). Phys. Rev., 130: 1127-30(May 1, 1963). (BNL-6582)

The lifetimes of the first excited states of $Mg^{25}$ and $Al^{25}$, at 0.58 and 0.45 Mev, respectively, were measured using a pulsed Van de Graaff beam technique. The mean lives were found to be (4.82 ± 0.10) nsec for $Mg^{25}$ and (3.33 ± 0.07) nsec for $Al^{25}$. (auth)

**19356** SPINS AND PARTIAL WIDTHS OF QUASIMOLECULAR RESONANCES IN $C^{12}$ + $C^{12}$ INTERACTIONS. E. Almqvist, D. A. Bromley, J. A. Kuehner, and B. Whalen (Atomic Energy of Canada Ltd., Chalk River, Ont.). Phys. Rev., 130: 1140-52(May 1, 1963).

Angular distributions for the reaction $C^{12}(C^{12},\alpha)Ne^{20}$ to levels in $Ne^{20}$ at 0, 1.63, 4.25, and 4.97 Mev and an unresolved doublet at 5.63-5.80 Mev were studied at incident energies near 6 Mev in the center-of-mass system. The results strongly suggest spins 2 and 4 for the quasimolecular states at 19.5 and 19.9-Mev excitation in $Mg^{24}$. The partial widths of these states reduced to units of $\hbar^2/MR^2$ appropriate to each channel are given; in these units the $C^{12}$ width is more than ten times the average width for $\alpha$ particle emission and one hundred times the average nucleon width. The nature of these states, which are prominent in the total reaction cross section, is discussed. (auth)

**19357** MONTE CARLO CALCULATION OF RESONANCE YIELD CURVES AND RESONANCE ENERGY DETERMINATION. D. W. Palmer, J. G. Skofronick, D. G. Costello, A. L. Morsell, W. E. Kane, and R. G. Herb (Univ. of Wisconsin, Madison). Phys. Rev., 130: 1153-62(May 1, 1963). (TID-16921)

Yield curves for the $Al^{27}(p,\gamma)Si^{28}$ reaction at 992 kev were studied extensively for thick and thin targets. Thick-target curves show a peak a few hundred ev above the resonance energy due to the discrete nature of energy losses suffered by protons as they penetrate the target. Theoretical thick and thin-target yield curves were obtained for this resonance by Monte Carlo calculations. Effects produced by discrete energy losses, by target contamination, and by nonuniform target thickness are investigated. Theoretical fits to experimental data for aluminum indicate that target contamination plays a major role in determining the shape of experimental thick-target yield curves. Experimental thick-target yield curves for the $Ni^{58}(p,\gamma)Cu^{59}$ resonances at 1424 and 1844 kev exhibit peaks in qualitative agreement with those predicted for other resonances by Monte Carlo calculations. (auth)

**19358** NUCLEAR MOMENT OF $Ni^{61}$ FROM NUCLEAR RESONANCE STUDIES IN STEADY EXTERNAL MAGNETIC FIELDS. Ralph L. Streever, Jr. (National Bureau of Standards, Washington, D. C.). Phys. Rev. Letters, 10: 232-4 (Mar. 15, 1963).

The nuclear magnetic resonance of $Ni^{61}$ was studied with free precession equipment in applied external magnetic fields of up to 10,000 gauss. At 77°K and above 2500 gauss the resonance frequency varies linearly with applied external field at a rate of 0.354 ± 0.020 Mc/kgauss sec, corresponding to an uncorrected nuclear moment of 0.70 ± 0.04 nm. Corrections for this value are discussed. (C.E.S.)

**19359** NEW $\beta^-$ ACTIVITIES INDUCED BY THE PHOTON BOMBARDMENT OF BORON-11. B. M. K. Nefkens (Purdue Univ., Lafayette, Ind.). Phys. Rev. Letters, 10: 243-5(Mar. 15, 1963).

The irradiation of boron-11 with high-energy photons induces several reactions involving energetic $\beta$ emitters. Decay curves of the $\beta$ activities obtained by irradiation of boron with 320-Mev bremsstrahlung are given. The endpoint energy of the $\beta$ emitters produced is 13.1 ± 0.5 Mev. Production cross sections for all $\beta$ activities with energies above 6 Mev are found to be larger than 160 $\mu$b. (C.E.S.)

**19360** ISOTOPIC, ISOTONIC, AND SHELL CLOSURE EFFECTS ON THE LARGE ANGLE SCATTERING OF POLARIZED PROTONS. L. Rosen and L. Stewart (Los Alamos Scientific Lab., N. Mex.). Phys. Rev. Letters, 10: 246-7(Mar. 15, 1963). (LADC-5651)

Detailed measurements on the elastic scattering of 14-Mev polarized protons out to 170° in the laboratory reference frame are reported. The nuclides studied are in the mass region 50-70 and encompass closed shells of neutrons and protons. The measurements comprise left-right asymmetries that are related to the polarization that would result from the elastic scattering of an unpolarized proton beam. Results obtained on a series of isotopes and isotones from Cr to Zn are given. (C.E.S.)

**19361** ANALOGUE STATES IN ISOBARIC NUCLEI. Charles D. Goodman (Oak Ridge National Lab., Tenn.). Phys. Rev. Letters, 10: 247-9(Mar. 15, 1963).

It is shown that certain nuclear energy levels, which can be identified through (p,d) reactions, are closely related to isobaric-spin analog states, and the energy difference between the appropriately identified level and the analog state is interpretable as an isobaric-spin splitting of a single particle resonance. Since the identification of the appropriate levels in the (p,d) energy spectra depends on shell-model arguments, the case of $Zr^{90}(p,d)Zr^{89}$ is chosen as an example since $Zr^{90}$ is a good approximation to a closed-shell nucleus, and the states created by (p,d) reactions can be interpreted as simple neutron hole states. (C.E.S.)

**19362** PHOTONEUTRON CROSS-SECTION RESONANCES IN $O^{16}$. D. W. Anderson, A. J. Bureau, B. C. Cook, J. E. Griffin, J. R. McConnell, and K. H. Nybo (Ames Lab., Ames, Iowa). Phys. Rev. Letters, 10: 250-3(Mar. 15, 1963). (IS-602)

The cross section for the reaction $O^{16}(\gamma,n)O^{15}$ was measured from the threshold to 60 Mev using bremsstrahlung from the Iowa State University 70-Mev synchrotron. The $O^{15}$ radioactivity yield curve was measured and the relative cross section extracted using least-structure analysis. Three activation curves were measured in each of two separate experiments in which different samples, beam geometries, and energy control systems were used. (C.E.S.)

**19363** EXPERIMENTAL TEST OF THE CONSERVED VECTOR CURRENT THEORY ON THE BETA SPECTRA OF $B^{12}$ AND $N^{12}$. Y. K. Lee, L. W. Mo, and C. S. Wu (Columbia Univ., New York). Phys. Rev. Letters, 10: 253-8(Mar. 15, 1963).

A precise measurement of the beta spectra of $B^{12}$ and $N^{12}$ was made as an experimental confirmation of the conserved vector current (CVC) theory. Great care was taken as to the precision of the results. End-point energies obtained from the Curie plots of the $\beta$ rays are 13.373 ± 0.04 and 16.43 ± 0.10 Mev for $B^{12}$ and $N^{12}$, respectively. This investigation confirms that the deviations from the allowed shape of the observed beta spectra for $B^{12}$ and $N^{12}$ have the correct magnitude and sign due to a weak magnetism term. This unique relation between the beta interaction and electrodynamics strongly supports the CVC theory. (C.E.S.)

**19364** OBSERVATION OF THE INTERNAL CONVERSION LINE FROM THE 6.052-Mev LEVEL IN $O^{16}$. Y. K. Lee, L. W. Mo, and C. S. Wu (Columbia Univ., New York). Phys. Rev. Letters, 10: 258-60(Mar. 15, 1963).

A search for the internal conversion line in $O^{16}$ was made. The line was found to be sharp enough to have its energy determined and its intensity estimated. The line provided a check on the theoretically predicted ratio of internal conversion to internal pair creation in the 6.052-Mev $0^+ \rightarrow 0^+$ transition in $O^{16}$. Agreement between the experimental points and the theoretical curves was very satisfactory. (C.E.S.)

**19365** THE COMPARISON OF THE ENERGY LEVELS OF $Gd^{152}$ WITH THE NONAXIAL NUCLEI THEORY. A. T. Strigachev. Vestn. Mosk. Univ., Ser. III, Fiz. Astron., No. 6, 20-3(Nov.-Dec. 1962). (In Russian)

The initial excitation levels of $Gd^{152}$, up to ~1320 kev, were analyzed and compared with nonaxial nuclear theory. (R.V.J.)

**19366** GIGANTIC RESONANCE ON HEAVY STRONGLY DEFORMED NUCLEI. L. Myunkhov. Vestn. Mosk. Univ., Ser. III, Fiz. Astron., No. 6, 37-44(Nov.-Dec. 1962). (In Russian)

An equation system was developed for determining dipole excitation energy using secondary quantization approximation. The calculated and normalized system was applied in the case of strongly deformed nuclei. (tr-auth)

**19367** ON NUCLEAR POLARIZATION IN MESIC ATOMS: THE POLARIZATION OF LIGHT PROTONS ON THE EXAMPLE OF $Bi^{209}$-MESIC ATOMS. Florian Scheck (Universität, Freiburg i. B.). Z. Physik, 172: 239-57(1963). (In German)

The polarization of the nucleus in mesic atoms by the revolving muon was previously calculated only with regard to the collective internal degrees of freedom of the nucleus. Supplementary to this calculation, the influence of muons on individual nucleons described in the framework of the shell model was investigated in an especially characteristic example: with the assumption of a rigid nuclear core, the polarization of the relatively loosely bound light protons of the Bi nucleus was calculated. The contribution of this single-particle nuclear polarization was proved, similarly to collective-particle, in consideration of the present accuracy of measurements to be negligibly small. (tr-auth)

**19368** DETERMINATION OF $g_K$-FACTORS OF 2+-ROTATIONAL STATES OF $W^{182}$ BY DIFFERENTIAL $\gamma\gamma$-ANGULAR CORRELATION MEASUREMENT IN EXTERNAL MAGNETIC FIELD. H. J. Koerner, J. Radeloff, and E. Bodenstedt (Universität, Hamburg). Z. Physik, 172: 279-92(1963). (In German)

The time spectrum of the coincidences between the $\gamma$-group at 1150 kev and the 100 kev radiation in the decay of $Ta^{182}$ was observed in an external magnetic field of 29300 ± 300 gauss at eight different angles. The analysis of these data which took into account the experimentally determined shape of the prompt resolution curve yields for the g-factor of the 2+ rotational state: $g_R = +0.336 \pm 0.044$. The angular correlation was found to be slightly attenuated by internal fields. The integral attenuation factor was determined as: $G_4 = (\lambda/\lambda + \lambda_4) = 0.91 \pm 0.05$. Liquid sources of tantalum fluoride solved in concentric hydrofluoric acid were used for these experiments. The half life of the 100 kev state was determined as: $T_{\frac{1}{2}} = (1.41 \pm 0.06) \cdot 10^{-9}$ s in agreement with earlier measurements. (auth)

**19369** DEPENDENCE OF THE $\gamma$-QUANTUM RESONANCE ABSORPTION SPECTRUM ON CRYSTAL TEMPERATURE. Pham Zuy Hien and V. S. Shpinel (Moscow State Univ.). Zh. Eksperim. i Teor. Fiz., 44: 393-7(Feb. 1963). (In Russian)

The spectra of resonance absorption of 23.8 kev $\gamma$ rays in $SnO_2$ are investigated from 78 to 645°K. Extrapolation of the observed line widths to zero absorber thicknesses leads to values greater than the natural width, which grow with increasing temperature. The experimental data show that the broadening is not the result of a doublet structure and that the true broadened line approximately has a Lorentz shape. The probabilities for absorption without recoil (f') are measured in the investigated temperature range. The values of f' weakly vary with the temperature. A linear dependence of the temperature line shift due to a second order Doppler effect was observed at $T \gtrsim 300$°K. Deviations from linearity occur at $T \lesssim 300$°K. (auth)

**19370** ON THE NATURE OF THE 3.79-Mev EXCITATION ENERGY LEVEL IN THE $Si^{30}$ NUCLEUS. M. I. Guseva, K. I. Zherebtsova, V. F. Litvin, Ya. A. Nemilov, and T. V. Orlova. Zh. Eksperim. i Teor. Fiz., 44: 421-3 (Feb. 1963). (In Russian)

A multi-angle magnetic analyzer is employed to study the energy spectra and angular distributions of protons from the reaction $Si^{29}(d,p)Si^{30}$ with $Si^{30}$ in the ground state and also at levels with excitation energies of 3.79 and 8.09 + 8.149 Mev. The spins, parities and relative reduced widths of these states are determined. (auth)

**19371** PHOTOPROTONS FROM $Nb^{93}$. R. M. Osokina (Lebedev Inst. of Physics, Moscow). Zh. Eksperim. i Teor. Fiz., 44: 444-53(Feb. 1963). (In Russian)

The angular and energy distributions and also the yield of photoprotons from $Nb^{93}$ are measured by the nuclear photographic emulsion technique for three values of the upper limit of the bremsstrahlung spectrum $E_{\gamma max} = 19.5$, 23.5, and 27.5 Mev. The results are compared with the predictions of the statistical theory of nuclear reactions, in which the effect of pair correlations of nucleons on the level density of the final nucleus is taken into account. It is shown that the measured photoproton yield exceeds the theoretical value by an order of magnitude. The photoproton spectrum is much harder than the "evaporation" spectrum. The angular distributions possess an anisotropy of the form $I(\theta) = a + b \sin^2 \theta$. From an analysis of the angular distributions it is concluded that E1 proton transitions of the $2p \rightarrow 2d$ type play an important role. (auth)

**19372** ANGULAR CORRELATION BETWEEN $\gamma$-PHOTONS AND 14-Mev NEUTRONS INELASTICALLY SCATTERED ON CARBON NUCLEI. B. A. Benetskii (Benetsky) and I. M. Frank (Lebedev Inst. of Physics, Moscow). Zh. Eksperim. i Teor. Fiz., 44: 454-61(Feb. 1963). (In Russian)

The angular n'γ correlation is investigated for 14-Mev neutrons inelastically scattered by carbon nuclei. The measurements are performed for neutron scattering angles of −24, 40, and 135°. (auth)

**19373** MEAN FREE PATH OF ~$10^{12}$ ev NUCLEONS IN CARBON. V. I. Rubtsov, Yu. A. Smorodin, and B. V. Tolkachov (Lebedev Inst. of Physics, Moscow). Zh. Eksperim. i Teor. Fiz., 44: 462-8(Feb. 1963). (In Russian)

The mean free path for inelastic interaction of ~$10^{12}$ ev nucleons in carbon was measured and found to equal 92 g/cm$^2$. The elementary cross section for inelastic nucleon-nucleon interaction calculated on basis of the optical model of the nucleus by applying the value cited above was 33 ± 7 mb. The results were compared with those obtained at lower energies. (auth)

**19374** CROSS SECTIONS FOR (n,p) REACTIONS ON TIN ISOTOPES FOR 14.5 Mev NEUTRONS. G. P. Chursin, V. Yu. Gonchar, I. I. Zalyubovskii (Zalyubovsky), and A. P. Klyucharev (Khar'kov State Univ. and Inst. of Nuclear Physics, Kazakh SSR). Zh. Eksperim. i Teor. Fiz., 44: 472-4(Feb. 1963). (In Russian)

The cross sections for the (n,p) reaction on the tin isotopes $Sn^{112,116,118,119,120}$ are measured by the activation method. The experimental values do not confirm a semi-empirical law of decrease of the (n,p) cross sections with growth of mass number. In order to make the theory consistent with the experimental data it is necessary to take into account shell effects in nuclei and the presence of strongly competing reaction channels on transition from isotope to isotope. (auth)

**19375** POLARIZATION OF PROTONS IN THE $He^3$(d,p)$He^4$ REACTION. A. K. Val'ter, N. Z. Skakun, A. P. Klyucharev, and A. G. Strashinskii (Strashinsky) (Inst. of Physics and Tech., Ukrainian SSR). Zh. Eksperim. i Teor. Fiz., 44: 475-7(Feb. 1963). (In Russian)

The angular dependence of the polarization of protons from the $He^3$(d,p)$He^4$ reaction is measured for ~2-Mev deuterons. Proton polarization is measured at angles 35, 44, 60, 75, and 90° in the laboratory system, and found to be respectively 2.7 ± 2.0, 5.4 ± 3.2, 7.6 ± 33.6, 5.8 ± 3.5, and 4.1 ± 3.4%. A helium polarimeter is employed for measuring the proton polarization. (auth)

**19376** EMISSION OF $Li^8$ FRAGMENTS FROM Ag AND Br NUCLEI INDUCED BY 9 Bev PROTON BOMBARDMENT. N. P. Bogachev, E. L. Grigorev, Yu. P. Merekov, and N. A. Mitin (Joint Inst. for Nuclear Research, Dubna, USSR). Zh. Eksperim. i Teor. Fiz., 44: 493-7(Feb. 1963). (In Russian)

The production of $Li^8$ from Ag and Br nuclei in a photographic emulsion bombarded by 9-Bev protons is investigated. Three hundred and fifty-eight $Li^8$ tracks are found in stars containing eight or more black rays. The yield per disintegration and energy and angular distributions are consistent with a mechanism of $Li^8$ evaporation from a highly excited nucleus. However, the large width of the energy spectrum is not in agreement with this picture. (auth)

**19377** DETERMINATION OF THE PARAMETERS OF THE GENERALIZED DIFFRACTION MODEL OF THE NUCLEUS AT 660 Mev. L. S. Azhgirei (Azhgirey) and S. B. Nurushev (Joint Inst. for Nuclear Research, Dubna, USSR). Zh. Eksperim. i Teor. Fiz., 44: 536-40(Feb. 1963). (In Russian)

A relation between the nuclear scattering amplitudes and the parameters of the generalized diffraction theory for scattering of high energy particles on atomic nuclei is established by taking into account spin-orbit interaction. The parameters of the generalized diffraction model are determined from the values of the amplitudes for scattering of protons on carbon nuclei. Spin effects are discussed. (auth)

**19378** MULTIPOLE EXPANSIONS IN DECAY PROCESSES. V. L. Luboshits. Zh. Eksperim. i Teor. Fiz., 44: 561-72(Feb. 1963). (In Russian)

A covariant form of expansion of an arbitrary electromagnetic vertex in relativistic multipoles is presented. Irreducible small group tensors $L_u$ (u is the 4-velocity of the center of inertia) are employed. For setting up these tensors from the wave amplitudes of the particles participating in the decay process, a transformation is applied that is connected with parallel transfer of vectors and spinors in Lobachevsky space. The same technique is employed for investigating the structure of the β decay Hamiltonian in the theory of universal weak interaction. The number of various types of form factors for β decay of particles with an arbitrary spin is computed and a relativistically invariant classification of β transitions in terms of degrees of forbiddenness is presented. (auth)

**19379** SCATTERING OF NEUTRONS BY MOLECULES WITH LARGE ENERGY TRANSFER. G. K. Ivanov. Zh. Eksperim. i Teor. Fiz., 44: 573-86(Feb. 1963). (In Russian)

Scattering of neutrons by molecules is investigated under the assumption that the energy transferred per collision is much greater than the mean difference between the vibrational energy levels of the molecules. It is shown that in this case the expression for the differential (with respect to energy and angle) scattering cross section can be represented by a few expansion terms, which are then averaged over angular orientations of the molecule. In the approximation defined by the senior expansion term some other important scattering characteristics are also found. The formulas derived refer to arbitrary molecules. For some types of molecules the finite expressions for the scattering cross sections have been reduced to single integrals and can readily be evaluated numerically. Results of the calculations for the water molecule are presented. (auth)

**19380** PHASE SHIFT ANALYSIS OF ELASTIC SCATTERING OF PROTONS ON TRITIUM NEAR THE THRESHOLD OF THE REACTION T(p,n)$He_3$. Yu. G. Balashko and A. B. Kurepin (Lebedev Inst. of Physics, Moscow). Zh. Eksperim. i Teor. Fiz., 44: 610-12(Feb. 1963). (In Russian)

A phase shift analysis for 990-kev protons elastically scattered by tritium is carried out. By employing the complexity of the angular dependence resulting from Rutherford scattering and the data for the threshold anomaly, it is possible to reduce the number of solutions to two, corresponding to resonance in the $^1S_0$ state. (auth)

**19381** ON EXCLUSION OF COHERENT SCATTERING FROM THE CROSS SECTION FOR SCATTERING OF SLOW NEUTRONS BY SIMPLE CRYSTAL LATTICES. V. S. Oskotskii (Oskotsky) (Inst. of Semiconductors, Academy of Sciences, USSR). Zh. Eksperim. i Teor. Fiz., 44: 657-9 (Feb. 1963). (In Russian)

A method for measuring the cross section for scattering of slow neutrons by simple lattices is proposed, in which coherent single-phonon scattering is removed. The pure incoherent scattering cross section can be used for determining the phonon distribution function in the crystal. The velocity of the incident neutrons should exceed the maximal velocity of sound in the crystal, and the scattering cross section should be measured near those directions along

which Bragg elastic scattering is possible. If the inelastic forward scattering cross section is measured, polycrystals may be employed for the measurements. Depending on the crystal under investigation the incident neutrons should not have a wavelength larger than 1.5 to 0.5 Å. (auth)

**19382** ON COHERENT INTERACTIONS BETWEEN HIGH-ENERGY PARTICLES AND NUCLEI. M. I. Podgoretskii (Podgoretsky). Zh. Eksperim. i Teor. Fiz., 44: 695-6(Feb. 1963). (In Russian)

The problem of the so-called critical momentum of primary particles for which the nucleus involved in the reaction does not recoil is considered. (auth)

**19383** ON THE THEORY OF INTERNAL CONVERSION OF γ-RAYS. V. F. Boldyshev (Inst. of Physics and Tech., Academy of Sciences, Ukrainian SSR). Zh. Eksperim. i Teor. Fiz., 44: 717-27(Feb. 1963). (In Russian)

Internal conversion of radiation of the magnetic and electric types in the K-shell is considered, for transitions of arbitrary multipolarity. Closed expressions for the conversion coefficients and angular distribution of the conversion electrons are obtained with an accuracy to terms of the order of aZ. (auth)

**19384** THEORY OF PHOTON SCATTERING IN THE COULOMB FIELD OF A NUCLEUS. S. S. Sannikov (Inst. of Physics and Tech., Academy of Sciences, Ukrainian SSR). Zh. Eksperim. i Teor. Fiz., 44: 728-34(Feb. 1963). (In Russian)

Elastic scattering of photons in a nuclear Coulomb field at high frequencies $\omega \gg m$ (m is the electron mass and $\omega$ the frequency of the incident photon) and large scattering angles $\theta \gg m/\omega$ is investigated by the dispersion relations method. The main contribution in the indicated angle range is from the real part of the scattering amplitude (whereas for small angle scattering the main contribution is from the imaginary part of the amplitude). An expression is derived for the differential cross section for scattering into angles $\theta \gg m/\omega$. (auth)

**19385** TWO TYPES OF FISSION AND THE NUCLEAR CHARGE DISTRIBUTION. V. P. Eismont. Zh. Eksperim. i Teor. Fiz., 44: 744-7(Feb. 1963). (In Russian)

Studies of partial fission yields are analyzed by taking into account data pertaining to the emission of instantaneous neutrons. It is noted that in the charge distribution as well as in the mass and fragment kinetic energy distribution, symptoms of the existence of two independent fission modes can be discerned. (auth)

**19386** FIZIKA DELENIYA ATOMNYKH YADER. (Physics of Nuclear Fission). N. A. Perfilov and V. I. Eismont, eds. Moscow, Gosatomizdat, 1962. 243p.

The physics of nuclear fission is discussed in 20 papers. Separate abstracts were prepared for 19. One paper was previously abstracted for NSA. (M.C.G.)

**19387** ASYMMETRY IN THE MASS DISTRIBUTION OF FISSION FRAGMENTS. B. T. Geilikman. p.5-11 of "Fizika Deleniya Atomnykh Yader." Moscow, Gosatomizdat, 1962.

Theoretical work available concerning one of the more important problems in fission, i.e., the explanation of the asymmetrical mass distribution of fission fragments, is summarized. Theories were recently proposed based on the liquid drop model. The nucleus, after passing through the saddle point but before breaking at the neck region, becomes unstable with respect to the asymmetric deformation parameter, $\alpha_3$. Another proposal is that the energy of the nucleus at the fissioning point can be looked upon as being equal to the sum of the energies of the resulting fragments plus their Coulomb interaction energy. By minimizing this sum the shape of the fissioning nucleus can be determined. It is clear, however, from experimental results that shell effects play a large role in fission, and, therefore, the liquid drop models are inadequate. Attempts were made to include shell effects at low excitation energies. At the present time the agreement between calculations that take into consideration shell effects and between experimental data is only qualitative in nature. (TTT)

**19388** STATISTICAL THEORY OF FISSION. G. A. Pik-Pichak and V. M. Strutinskii. p.12-23 of "Fizika Deleniya Atomnykh Yader." Moscow, Gosatomizdat, 1962.

In nuclear fission taking place at high excitations the exchange of energy between different steps in the deformation process occurs sufficiently fast in comparison with the velocity of deformation. Under such circumstances, the mass and charge distributions, the fluctuations in the fragment kinetic energies and in the total energy can all be determined by statistical weights at the moment of fission. Expressions were derived for the most probable mass, $\bar{A}(Z)$, for a given charge number, and for the most probable charge, $\bar{Z}(A)$, for a given mass number. The theoretical calculations were compared with experimental results obtained in the bombardment of $Au^{197}$ with $C^{12}$ ions. The best agreement was obtained if it was assumed that only a few neutrons, (0 to 4), are emitted prior to fission. This is in contradiction to the experimenter's proposal that the fissioning occurs at the end of the neutron cascade. (TTT)

**19389** ASYMMETRIC FISSION. A. N. Protopopov. p.24-47 of "Fizika Deleniya Atomnykh Yader." Moscow, Gosatomizdat, 1962.

The basic characteristics of asymmetric and symmetric fission were examined. Existing experimental data on mass distributions in the fission of heavy elements induced by particles of low and medium energies are discussed. Asymmetric fission is characterized by a slow process during which time the nucleus preforms the fragments around the magic closed-shell structures. Symmetric fission is a fast process in which a highly excited nucleus fissions without the emission of neutrons. While the probability for asymmetric fission depends little on the excitation energy of the compound system, the probability for symmetric fission rises sharply with increasing excitation energy. For energies up to 40 Mev asymmetric fission is the dominant type; for energies greater than 40 Mev the probability for the two types of fission becomes comparable. The influence of closed shells is felt in asymmetric fission for energies up to 20 Mev. This influence carries over into the two maxima found in the mass distribution for asymmetric fission; A = 83 to 86 (50-neutron closed shell), and A = 127 to 139 (50-proton and 82-neutron closed shells). The two maxima in asymmetric fission broaden as the mass of the fissioning nucleus is increased and as the excitation energy is increased. (TTT)

**19390** RADIOCHEMICAL RESEARCH ON FISSIONING OF $Am^{241}$ BY NEUTRONS OF DIFFERENT ENERGIES. N. I. Borisova, B. V. Kurchatov, V. I. Novgorodtseva, V. A. Pchelin, L. V. Chistyakov, and V. M. Shubko. p.48-53 of "Fizika Deleniya Atomnykh Yader." Moscow, Gosatomizdat, 1962.

$Am^{241}$ was separated from long-decayed Pu and electrolytically deposited on a Pt disk. It was irradiated in a vertical channel of the IRT reactor in a field of $5 \times 10^{12}$ n/cm$^2$/sec, with and without filters. The ratio of other fission products to $Mo^{99}$ under various conditions was essentially the same as that obtained in the BEPO reactor except for $Sn^{121}$. The ratio of symmetrical to asymmetrical fissioning

increased markedly in going from slow to fast neutrons. Simultaneously there was a small but steady decrease in the $Ba^{140}$ yield. The ratio of the yields of corresponding products of fissioning by thermal neutrons and first resonance neutrons were equal within the limits of error. The mass yield curve in $Am^{241}$ fissioning by thermal neutrons showed a minimum about 4 times lower than that of $Pu^{239}$. Points for $Sn^{125}$ were much lower on the curve. (TTT)

**19391** NUCLEAR FISSION AND ANGULAR ANISOTROPY OF FISSION FRAGMENTS. V. M. Strutinskii. p.54-60 of "Fizika Deleniya Atomnykh Yader." Moscow, Gosatomizdat, 1962.

Radiochemical analysis was made of the ratio of asymmetric to symmetric events in $Am^{241}$ fission by thermal, fast, and 0.31, 0.58, and 1.27 ev resonance neutrons. The $Am^{241}$ nucleus with $5^-/_2$ spin, forming a compound nucleus in $2^-$ and $3^-$ states and having a sub-barrier, rendered an additional interest because of the two spin-states with different thresholds. The relative yields of $Mo^{99}$ in $Am^{241}$ fission at various neutron energies were tabulated. The table indicates an increase in the ratio of symmetric–asymmetric fission events in transition from slow to fast neutrons. (R.V.J.)

**19392** ANGULAR ANISOTROPY OF FISSION. V. P. Eismont. p. 61-97 of "Fizika Deleniya Atomnykh Yader." Moscow, Gosatomizdat, 1962.

The available experimental data on angular anisotropies of fission fragments are summarized and compared with theoretical calculations. The summary examines the dependence of the anisotropy on the target nucleus, on the type and energy of the particle inducing fission, and on the mass of the fission fragments. Many of the experimental results can be understood in terms of the collective model. The angular distribution of the fragments is given by the state of the nucleus at the saddle point and therefore depends on the form and the temperature of the transition nucleus and on the distribution of the projection of the angular momentum on the symmetry axis. The statistical theory offers an alternative explanation for the fragment distribution by considering the spin distribution of the fragments. A connection between the anisotropy and the form of the system at the fissioning point and the mass and kinetic energies of the fragments is discussed. In conclusion a table is presented that lists all of the known experimental and theoretical references on the subject of angular anisotropies of fission fragments. (TTT)

**19393** PROMPT NEUTRONS AND GAMMA-RAYS IN FISSION. Yu. S. Zamyatnin. p.98-120 of "Fizika Deleniya Atomnykh Yader." Moscow, Gosatomizdat, 1962.

The experimental data obtained in the last five years on prompt neutrons and gamma rays emitted in fission were examined. Because these prompt emissions originate from highly excited fragments their study can lead to the knowledge of the fragment excitation energies, and perhaps can shed some light on the fission process. Data showed the dependence of the fragment excitation energy on the atomic and mass numbers and on the excitation energy of the fissioning nucleus. Neutron energy spectra and angular distributions shed light on the mechanism and formation of these neutrons. Studies of time characteristics and angular anisotropies of fission gamma rays also cleared up many of the points concerned with the formation mechanism of these gamma rays. The determination of fission fragment x-ray spectra yielded a method for the study of the charge distribution of the fragments. The calculated and experimental values of the excitation energy carried off by the gamma rays do not agree. (TTT)

**19394** SPECTRA AND MEAN NUMBER OF NEUTRONS EMITTED IN THE FISSION OF $Th^{232}$ AND $U^{233}$ BY NEUTRONS WITH AN ENERGY OF 14.3 Mev. Yu. A. Vasil'ev, Yu. S. Zamyatnin, E. I. Sirotinin, P. V. Toropov, E. F. Fomushkin, and V. I. Shamarukhin. p.121-6 of "Fizika Deleniya Atomnykh Yader." Moscow, Gosatomizdat, 1962.

Spectra were obtained for neutrons emitted in the fission of $Th^{232}$, $U^{233}$, and $U^{235}$ induced by 14.3-Mev neutrons. The time-of-flight method was used to determine the spectra in the energy interval 0.3 to 5.0 Mev. The incident neutrons were produced by bombarding a tritium target with deuterons. The emitted neutrons were detected by a scintillation counter placed 75 cm from the targets and at an angle of 90° to the direction of the deuteron beam. The spectra could be approximated by a distribution function from which the parameters T, $T_f$ and $\alpha$ were determined and compared to the same values obtained previously for the fission of $U^{238}$ and $U^{235}$. The two sets of $U^{235}$ values agreed very well. A monotonic dependence was found for these parameters on $Z^2/A$. The mean number of neutrons was determined from the energy spectra: for $U^{235}$, $4.11 \pm 0.30$; for $U^{233}$, $4.20 \pm 0.30$; and for $Th^{232}$, $3.68 \pm 0.25$. These numbers are in good agreement with values obtained by other authors working at slightly different incident neutron energies. (TTT)

**19395** COMPARISON OF SPECTRA OF PROMPT NEUTRONS EMITTED IN THE SPONTANEOUS FISSION OF $Pu^{240}$ AND THE INDUCED FISSION OF $Pu^{239}$. V. I Bol'shov, L. D. Gordeeva, V. F. Kuznetsov, and G. N. Smirenkin. p.127-33 of "Fizika Deleniya Atomnykh Yader." Moscow, Gosatomizdat, 1962.

The prompt neutron spectra were compared in the spontaneous fission of $Pu^{240}$ and in the fission of $Pu^{239}$ induced by slow neutrons. The purpose was to observe the differences arising from the fission of the same compound nucleus ($Pu^{240}$) but at different excitations. The energy difference for this comparison is 6.3 Mev. The spectra were measured by using a single-crystal stilbene scintillation spectrometer. The spectra were obtained for prompt neutrons 2 to 12 Mev in energy. The data were best fitted by the following values of the nuclear temperature: 1.24 Mev for the spontaneous fission of $Pu^{240}$ and 1.44 Mev for the induced fission of $Pu^{239}$. Values of the temperature for the spontaneous fission of $Pu^{240}$ are absent in the literature; published values for the induced fission of $Pu^{239}$ range from 1.25 to 1.52 Mev. The data indicated a stiffening in the prompt neutron spectra in going from the spontaneous fission occurring below the Coulomb barrier to slow neutron fission above the barrier. (TTT)

**19396** SPONTANEOUS FISSION OF NUCLEI. V. A. Druin and G. N. Flerov. p.134-44 of "Fizika Deleniya Atomnykh Yader." Moscow, Gosatomizdat, 1962.

The subject of spontaneous fission is reviewed. The fission process involves a reshuffling of the nuclear core and is very much of a collective phenomenon. Single-particle aspects, however, also play a role as shown by the large hindrance factor for spontaneous fission of odd-mass nuclei; the addition of only one nucleon to an even-even nucleus greatly lowers the fission probability. Experimental data on spontaneous fission half lives are summarized and shown in a plot of the half life versus the parameter $Z^2/A$. Spontaneous fission can be regarded as a barrier penetration mechanism. The study of half-lives for different nuclei can lead to information concerning: the height of the potential barrier and its penetrability, the nuclear shape at the saddle point, and, in some cases the energy states of individual nucleons in deformed nuclei. For the transfermium

elements data are summarized concerning the spontaneous fission of $102^{254}$. The published half life for this isotope is about $10^5$ times less than the one expected from systematics. The data can be explained by the presence in the sample of some heavier isotope of element 102 such as $102^{256}$, a nuclide whose spontaneous fission half life would be expected to be very short. (TTT)

**19397** LONG-RANGE ALPHA PARTICLES IN THE SPONTANEOUS FISSION OF TRANSURANIC ELEMENTS. N. A. Perfilov, Z. I. Solov'eva, R. A. Filov, and G. I. Khlebnikov. p.145-50 of "Fizika Deleniya Atomnykh Yader." Moscow, Gosatomizdat, 1962.

Investigations were made of spontaneous fission in the transuranic region accompanied by the emission of long-range alpha particles. The samples used were $Cm^{242}$ and $Pu^{240}$. The alpha particles were detected using emulsions. Energy spectra were obtained for alphas whose energies were greater than 13 Mev. The maxima in these spectra occurred at 15.5 ± 1.0 Mev for Cm and at 17.0 ± 0.5 Mev for Pu. The spectra were extrapolated to lower alpha energies by assuming that the distributions were Gaussian. In this way ratios were determined for the probability of fission accompanied by alphas as compared to the probability for ordinary binary fission. These ratios were: 1/280 ± 50 for $Cm^{242}$ and 1/400 ± 60 for $Pu^{240}$. These numbers were compared with the ones published for $Cf^{252}$. It was found that the published $Cf^{252}$ values vary substantially among themselves. (TTT)

**19398** ENERGY CORRELATION IN TERNARY FISSION OF URANIUM. V. N. Dmitriev, L. V. Drapchinskii, K. A. Petrzhak, and Yu. F. Romanov. p.151-4 of "Fizika Deleniya Atomnykh Yader." Moscow, Gosatomizdat, 1962.

The fission of $U^{233}$ was investigated to determine the energy distribution of fragments emitted in ternary fission. In all 8000 ternary fission events and 10000 binary fission events were registered. It was found that the most probable total energy of the fragments in binary fission was 16 ± 1 Mev greater than the total fragment energy in ternary fission. The energy difference is carried off by the long-range alpha particle emitted in ternary fission. This agrees with earlier work on $U^{233}$ ternary fission which has shown that the most probable alpha energy is 16.5 Mev. The fission fragment yield for both types of fission was plotted as a function of $M_1/M_2$, where $M_1$ and $M_2$ are the masses of the two fragments. It was found that the distributions were similar for both types of events and that they both peaked for $M_1/M_2 = 1.5$. Because of this similarity in the mass distributions it is supposed that the alpha particle is emitted at the last moment of fission when the fragments are already formed. (TTT)

**19399** NEUTRON SPECTROMETRY OF FISSIONING NUCLEI. M. I. Pevzner. p.155-65 of "Fizika Deleniya Atomnykh Yader." Moscow, Gosatomizdat, 1962.

Experimental data on fission obtained by the technique of neutron spectrometry are summarized. Information learned by means of this technique is listed: the widths of resonance states in heavy nuclei are not constant and vary from state to state; the change in the fission cross section in the resonance state region is asymmetric with respect to the resonance energy; the fission cross section between the resonance regions cannot be described by the superposition of the contributions due to the separate Breit-Wigner states; the fission cross section in the thermal region for all nuclei that can be fissioned with thermal neutrons can only be explained to a small degree by the influence of neighboring known states; and the ratio of the capture cross section to that of the fission cross section for all thermal neutron fissioning nuclei decreases with decreasing neutron energy and has a maximum in the region of the resonance states. (TTT)

**19400** NUCLEAR FISSION AT EXCITATION ENERGIES OF 20–100 Mev. G. A. Pik-Pichak. p.166-74 of "Fizika Deleniya Atomnykh Yader." Moscow, Gosatomizdat, 1962.

The dependence of fission probability on excitation energy and angular momentum was considered. A formula was derived that gives the dependence of $\Gamma_f/\Gamma_c$ on excitation energy, where $\Gamma_f$ is the fission width and $\Gamma_c$ is the width for capture. This dependence was compared with data on $Au^{197}$, $Pb^{206}$, $Pb^{207}$, and $Bi^{209}$ fission induced by alpha particles. It was found that in the region of 40 Mev the gold data disagree with the calculated curves, while for the lead and bismuth results there is no discrepancy at the same maximum incident alpha energy. Fission induced by heavy ions, where for the same excitation energy a much larger amount of angular momentum is brought into the compound system than for fission induced by lighter particles, was investigated. It was found that there is a larger fission cross section for more angular momentum brought into the system. The compound nucleus, $Tl^{197}$, was produced in two ways, by bombardment with $O^{16}$ and $C^{12}$ ions. The ratio $(\delta_f/\delta_c)O^{16}$ to $(\delta_f/\delta_c)C^{12}$ was found to be 2.0 experimentally and agrees with the calculated ratio of 2.1. The quantity $(\delta_f/\delta_c)$ is the ratio of the fission cross section to the cross section for capture. The calculation was done for an excitation energy of 60 Mev. (TTT)

**19401** NUCLEAR FISSION BY HIGH-ENERGY PARTICLES. N. A. Perfilov. p.175-202 of "Fizika Deleniya Atomnykh Yader." Moscow, Gosatomizdat, 1962.

Data available on fission induced by particles with energies in the tens and hundreds of Mev were examined to determine the influence of excitation on the mass distribution of the products and on the value of the fission cross section. It was found that as the excitation energy increases the mass distribution indicates an initial increase in symmetrical fission. As the energy increases further the mass distribution curve becomes wider with an accompanying decrease in symmetrical fission. Asymmetric fission is noted not only for atomic numbers greater than 90 but also for the fission of bismuth. The ratio of the fission cross section to the total cross section increases with energy up to a particular energy for a given atomic number and then depends little on the energy. For uranium and plutonium it was found that up to 100 Mev $\Gamma_f/\Gamma_n$ does not depend on the energy and $\Gamma_f$ (width for fission) is greater than $\Gamma_n$ (width for neutron emission). For lead and bismuth, up to 50 Mev $\Gamma_f/\Gamma_n$ increases with energy. There is an insufficient amount of data on elements lighter than lead to say what the relation between $\Gamma_f$ and $\Gamma_n$ is. (TTT)

**19402** SOME RESULTS ON THE INTERACTION OF FAST PROTONS WITH HEAVY NUCLEI WITH REGARD TO FISSION. B. N. Belyaev and A. N. Murin. p.203-9 of "Fizika Deleniya Atomnykh Yader." Moscow, Gosatomizdat, 1962.

The momentum distribution was determined for final nuclei produced in the bombardment of $Bi^{209}$ by 135-Mev protons. The number of events was plotted versus $p_{||}/p_{c.n.}$ and $p_{\perp}/p_{c.n.}$, where, $p_{||}$ and $p_{\perp}$ are the nuclear momenta parallel and perpendicular to the beam, and where $p_{c.n.}$ is the momentum of the compound nucleus. The data were plotted in two ways, first, taking into account only cascades, and, second, considering in addition the evaporation process. From the average values of $p_{||}/p_{c.n.}$ and $p_{\perp}/p_{c.n.}$ the average excitation was determined to be 67 Mev for an $r_0$ of

1.45 and 77 Mev for $r_0 = 1.30$. The average excitation was plotted versus $p_{||}/p_{c.n.}$ for the two values of $r_0$ and taking into account first only cascades and then cascade and evaporation processes. The points fell on the same curve indicating that the dependence of the excitation on $p_{||}$ is the same whether evaporation is considered or not. The total fission cross section was measured to be 95 ± 13 mb, which agrees with previously published values of 80 and 125 mb. The mean number of neutrons emitted in the process was found to be 10 to 11 in good agreement with the value of 10 ± 2.7 obtained in an earlier investigation of $Bi^{209}$ fission induced by 147-Mev protons. (TTT)

**19403** RADIOCHEMICAL STUDY OF ISOTOPES OF THE RARE EARTH ELEMENTS FORMED IN PHOTO-FISSIONING OF URANIUM. A. K. Lavrukhina, V. I. Gol'danskiĭ, G. M. Kolesov, E. V. Minarik, and Syao-en Tan. p.210-16 of "Fizika Deleniya Atomnykh Yader." Moscow, Gosatomizdat, 1962.

Data were obtained for 25 isotopes identified as products of the photo-fissioning of uranium by gamma quanta with maximum energies of 100 and 250 Mev. Only neutron-surplus isotopes of the rare earth elements and yttrium were formed, which is characteristic for $U^{235}$ fissioning by thermal neutrons. With increase in the gamma energy from 100 to 250 Mev, this yield of $La^{140}$, $Pr^{143}$, $Pr^{145}$, $Pm^{148}$, and $Sm^{156}$ increased threefold or more. The yield of asymmetric fission products increased regularly with increase in the excitation energy of the nucleus. This was especially clearly defined for products with $A \geq 510$. An increase in the excitation energy that caused the fissioning of the nucleus led to a broadening of the curve of distribution of nuclear charge. However, there is probably a limit in the magnitude of the energy, above which the fission product distribution relative to the most probable charge does not depend on the nature of the bombarding particle. (TTT)

**19404** RANGE CHARACTERISTICS IN PROTON INDUCED FISSION OF LEAD NUCLEI. V. F. Darovskikh. p.226-30 of "Fizika Deleniya Atomnykh Yader." Moscow, Gosatomizdat, 1962.

Lead was bombarded by 660-Mev protons and fission events were investigated. The ranges of the light and heavy fragments were determined. The average sum of the two ranges was then plotted as a function of the ratio light fragment range/heavy fragment range. It was found that the sum of the ranges peaked in two places, where the range ratio was 1.25 and 1.60. The fragments were also divided into two groups, those that went in the backward and forward directions, respectively. In this way the effect of the velocity given to the compound nucleus by the incoming proton on the fissioning process could be studied. The velocity was additive for the forward fragments and subtractive for the backward fragments. No effect was seen; the peaks for both classes of fragments still appeared at the same range ratios. The number of events was also divided into those that were accompanied by zero, one, two, three, and four or five charged particles and plotted versus the range ratio. It was found that fission accompanied by fewer charged particles tended to be more symmetrical than those events accompanied by charged particle emission. The results can be explained if one supposes that a large fraction of fission takes place after much of the excitation energy is lost. (TTT)

**19405** FISSIONING OF HEAVY-ELEMENT NUCLEI IN NATURE. A. K. Lavrukhina. p.231-41 of "Fizika Deleniya Atomnykh Yader." Moscow, Gosatomizdat, 1962.

In connection with the theory that fissioning of the nuclei of heavy elements is the source of stellar energy, the distribution of rare earth isotopes in chondrites and the rocks of the earth's crust was compared. The isotopic compositions of the elements in the two sources were similar. In chondrites, for the majority of the most abundant rare earths with even Z numbers (Ce, Gd, Dy, Er, and Yb), the lightest isotopes were lower. The heavier isotopes varied from 10 to 30% of the total for each element except $Ce^{140}$, which was 88.5%. For Sm, the ratio of the most abundant isotope to the lightest was very low. For Nd, the light isotopes were more abundant than the heavy and the content of isotopes with odd values of N showed the sharpest decrease. Among those with odd Z numbers, only three had two stable isotopes. Many natural rare earth isotopes were shown to be radioactive. Calculations indicated that in the spontaneous fissioning of $Cf^{254}$, about 4% of the yield is $Sm^{147}$ while each of the isotopes $Ce^{142}$, $Pr^{141}$, $Nd^{143}$, $Nd^{144}$, $Nd^{145}$, $Nd^{148}$, $Nd^{150}$, $Sm^{147}$, $Sm^{149}$, and $Eu^{151}$ makes up 1 to 3%. Thermal neutron fissioning of $U^{235}$ and other members of the $(4n + 3)$ series gives particularly La, Ce, Pr, Nd, and Sm. Fissioning of uranium by high-energy protons differs from slow-neutron or spontaneous fissioning in that light rare earth isotopes are formed. Because of this the isotopic composition of rare earths formed in uranium fissioning by 660-Mev protons is different from that in chondrites and the rocks of the earth's crust. (TTT)

**19406** NUCLEAR PHYSICS. PART B. Luke C. L. Yuan and Chien-Shiung Wu, eds. Methods of Experimental Physics. Volume 5. New York, Academic Press, 1963. $22.50.

A review is presented of the determination of nuclear masses, moments, and reactions; particle masses; spins and parities; electron and photon polarization; and fluxes and densities. Summaries are given of properties of radiation sources and beam transport systems. Statistical fluctuations in nuclear processes are detailed. (T.F.H.)

**19407** INTRODUCTION TO NUCLEAR PHYSICS. Anwar Hossain and Inam-Ur-Rahman. [Lahore], Pakistan Atomic Energy Commission, 1962. 210p. Rs. 15.00.

A view of the wide frontier now open in the field of nuclear science is given. A great number of topics are covered simply with the least possible mathematics and a great number of illustrations, since the text is introductory in nature. The structure of the atom and basic nuclear concepts such as binding energy, nuclear stability, and nuclear models are discussed. Nuclear reactions, radioactive decay, and particle accelerators are reviewed. Radiation effects on matter and radiation detectors are covered along with recent developments in the field of nuclear physics. (C.E.S.)

**19408** MEASUREMENT AND CALCULATION OF RESONANCE ABSORPTION IN GOLD, URANIUM AND THORIUM FOILS. Manfred Brose. Thesis, Karlsruhe, Ger., Universität, 1962. 139p. $2.00; 8 DM.

The [neutron] resonance absorption in gold, uranium, and thorium foils is studied experimentally and theoretically. Up to now only data for the resonance absorption in uranium and thorium rods were available. The measurements were made with gold foils because the resonance parameters of gold are very accurately known. The neutron resonance absorption was calculated theoretically with approximate formulas that include the Doppler effect. The results are in agreement with the measured values for gold and uranium. For thorium larger discrepancies were found that can be explained by the fact that the resonance parameters are not accurately known. (Gmelin Inst.)

# Particle Accelerators

*Refer also to abstracts 18512, 18513, 18514, 18515, 18516, 18517, 18518, and 18529.*

**19409** (BNL-772) EXPERIMENTAL PROGRAM REQUIREMENTS FOR A 300 TO 1000-Bev ACCELERATOR. Luke C. L. Yuan, ed. DESIGN STUDY FOR A 300 TO 1000-Bev ACCELERATOR. John P. Blewett, ed. (Brookhaven National Lab., Upton, N. Y.). Aug. 28, 1961. Revised Dec. 1962. Contract [AT(30-2)-Gen-16]. 174p. (BNL-T-290)

I. Determination of the experimental program requirements for a 300- to 1000-Bev accelerator involved examining the need for such a machine, reviewing interactions in the $10^{12}$-ev energy range, studying particle production and secondary beams from such a device, considering beam separation techniques, exploring shielding problems, investigating particle detection and identification techniques, and considering specific experiments for the accelerator. II. The design study dealt with choice of accelerator type (alternating-gradient), particle dynamics in alternating-gradient synchrotrons, choice of basic parameters, injection techniques, magnet design, r-f acceleration methods, vacuum system requirements, instrumentation and control, plant arrangement, costs and manpower requirements. The possibility of installing 40- to 70-Bev electron synchrotrons in the same tunnels as the proton accelerator was also explored as was the practicability of a fixed-field alternating-gradient accelerator using superconducting air core magnets. 202 references. (D.C.W.)

**19410** (BNL-6880) COMPARISON OF LUMPED AND DISTRIBUTED INFLECTOR MAGNETS. E. B. Forsyth (Brookhaven National Lab., Upton, N. Y.). Mar. 18, 1963. Contract AT(30-2)-Gen-16. 10p.

Desirable characteristics of pulsed magnets used as ejectors or inflectors for large accelerators can be obtained by loading the magnet with distributed capacitance or by using a capacitor in shunt with the load. Comparable field build-up times are available with either arrangement. The lumped magnet system offers greater simplicity. (D.C.W.)

**19411** (BNL-6902) PHASE ACCEPTANCE AND BUNCHING IN THE AGS LINAC. Internal Report. J. P. Blewett (Brookhaven National Lab., Upton, N. Y.). Mar. 27, 1963. Contract [AT(30-2)-Gen-16]. 44p.

Phase acceptance of the Alternating-Gradient Synchrotron Linear Accelerator is theoretically examined and found to agree well with an experimental determination of phase acceptance. Bunching in the AGS linac is also analyzed, the results indicating a satisfactory understanding of this process also. A double buncher that should be more efficient than the present single buncher is discussed, and space charge effects (as yet unobserved in bunching) are analyzed. (D.C.W.)

**19412** (BNL-6922) RIPPLE FILTER FOR AGS MAIN MAGNET POWER SUPPLY. Internal Report. H. J. Halama (Brookhaven National Lab., Upton, N. Y.). Apr. 3, 1963. Contract [AT(30-2)-Gen-16]. 10p.

Design and operation of an electronic ripple filter to be used with the Brookhaven alternating-gradient synchrotron during flattop at energies between 10 and 30 Bev are discussed. (D.C.W.)

**19413** (CEAL-1001) DESIGN OF MODIFIED QUADRUPOLE MAGNETS. Michael Goitein (Cambridge Electron Accelerator, Mass.). Nov. 1962. Contract [AT(30-1)-2076]. 21p.

Modifications to the shape of ideal quadrupole magnets were investigated, using an electrolytic tank method. Magnets with straight and with exponential pole faces were considered with 1:1, 1:2, and 1:3 apertures. The additional field introduced by these modifications was expressed in an harmonic series and the coefficients of this series plotted against the parameters characterizing the modifications made. (auth)

**19414** (CEAL-1002) BEAM TRANSPORT CALCULATIONS USING GRAPHS. W. I. B. Smith (Cambridge Electron Accelerator, Mass.). Jan. 15, 1963. 12p.

The spread of a beam of particles can be represented by an ellipse in phase space, which represents the spread of the beam in both angle and distance. It is shown that the changes in this ellipse can be followed simply by graphical means, as the beam passes through an optical system consisting of thick and thin lenses and drift spaces. Such calculations are of value when an injected beam must be matched to an accelerator, or when a beam of particles from an accelerator must be transported to an experiment or through an analyzing system. The graphical calculation is quicker than a computer calculation, and should be of sufficient accuracy in most cases. The graphical calculation gives insight into the changes necessary in a beam transport system to give it the desired properties. (auth)

**19415** (CEAL-1003) SEMIANNUAL REPORT FOR THE PERIOD JULY 1 TO DECEMBER 31, 1962. (Cambridge Electron Accelerator, Mass.). Feb. 8, 1963. Contract AT(30-1)-2076. 14p.

The status of experiments on electron scattering, photoproduction of mesons, wide-angle muon pair production, photoproduction of pairs with large momentum transfers, photoproduction of sigma particles, pion production in peripheral processes, wide-angle electron pair production, and the Compton effect at 1 to 3 Bev is summarized. The status of shielding studies, spark chamber studies of photoproduction, and bubble chamber investigations are also included. Magnets, targets, ejection-type vacuum chambers, photon-beam drift tubes and collimators, detectors, cables, cryogenic cooling equipment, radiation detectors, and construction of supplementary shielding walls were involved in design efforts and procurement of equipment and facilities. Modifications and improvements at the accelerator proper were made on the magnet power supply, the r-f system, the Drivac high-vacuum pumps and other components and facilities. Operation at energies up to 6.2 Bev and with intensities up to 30% of design intensity ($6 \times 10^{12}$ electrons/sec) was achieved. Data of a technical nature are very limited. (D.C.W.)

**19416** (HW-SA-2664) OZONE HAZARDS ASSOCIATED WITH THE OPERATION OF AN ELECTRON VAN DE GRAAFF ACCELERATOR. F. E. Adley, H. V. Larson, J. S. Loomis, I. T. Myers, and D. E. Wisehart (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). [July 19, 1962]. Contract AT(45-1)-1350. 11p.

Liquid nitrogen used to cool graphite during graphite damage experiments in which electrons of 2 Mev in beam strengths of 100 μa bombarded the graphite was found to form a substance that caused severe upper respiratory irritation. The substance was identified as ozone, and a study of health and explosion hazards due to its presence was performed. Steps were taken to eliminate beam passage through the nitrogen, and beam dissipation in air was found to produce insignificant amounts of ozone. (D.C.W.)

**19417** (NP-12655) PROPOSAL FOR A 10 Bev HIGH INTENSITY ACCELERATOR. (Midwestern Universities Research Assn., Madison, Wis.). Mar. 30, 1962. 193p.

Cost estimates, design, operational principles, and results of design studies are given for a proposed 10-Bev proton spiral-sector fixed-field alternating-gradient accelerator that could produce over $10^{15}$ high-energy protons/sec. Calculations of orbits, particle yields, resultant radiation levels, shielding requirements, and magnetic field are discussed, and achievements of small prototype (400 kev and 50 Mev) accelerators are reviewed. 60 references. (D.C.W.)

**19418** (ORNL-3412) NUCLEON-MESON CASCADE CALCULATIONS: TRANSVERSE SHIELDING FOR A 45-Gev ELECTRON ACCELERATOR (PART III). R. G. Alsmiller, Jr., F. S. Alsmiller, and J. E. Murphy (Oak Ridge National Lab., Tenn.). Mar. 28, 1963. Contract W-7405-eng-26. 30p.

In two previous reports nucleon-meson cascade calculations were carried out for several cases of interest in the design of the transverse shield for the proposed 45-Bev linear electron accelerator at Stanford University. Results are now given for two additional cases. (auth)

**19419** (SLAC-11) MISALIGNMENT AND QUADRUPOLE ERROR EFFECTS IN A FOCUSING SYSTEM FOR THE TWO-MILE ACCELERATOR. R. H. Helm (Stanford Univ., Calif. Stanford Linear Accelerator Center). Jan. 1963. Contract AT(04-3)-400. 56p.

As a follow-up to a previous examination of possible focusing systems for the two-mile accelerator, the perturbing effects of various misalignments and errors in quadrupole spacing and strengths and in accelerator section location and movement are considered. Expressions are derived for the trajectory perturbations due to the various causes. Tolerances are determined for various sources of errors for an assumed focusing system. (D.C.W.)

**19420** (SLAC-12) SPACE-CHARGE LIMIT AND CONFINEMENT IN PARTICLE ACCELERATION WITH HIGH-INTENSITY LIGHT WAVES. J. J. Muray (Stanford Univ., Calif. Stanford Linear Accelerator Center). Jan. 1963. Contract AT(04-3)-400. 22p.

Use of the strong electric fields from laser radiation to accelerate particles is complicated by many technical and theoretical problems. Effects of space charge in medium energy accelerators are examined, and the maximum current (proportional to the product of the wavelength and accelerating field) that can be accelerated using optical frequencies is calculated. The laser accelerator average current proves to be about $10^{-3}$ that of the microwave accelerator current, but the product of accelerator length and average current is about equal for the two types of accelerators. Due to the high field strength in optical accelerators, the equivalent d-c confinement force can be significant and may be used for particle beam confinement or for medium-energy beam acceleration. (auth)

**19421** (SLAC-14) OPTICAL PROPERTIES OF QUADRUPOLE MULTIPLETS FOR SECTOR FOCUSING IN THE TWO-MILE ACCELERATOR. R. H. Helm (Stanford Univ., Calif. Stanford Linear Accelerator Center). Feb. 1963. Contract AT(04-3)-400. 33p.

Previous studies of focusing systems for the two-mile accelerator were based on a system of quadrupoles with 40-ft spacing. Tight alignment tolerances imposed by the 40-ft system prompted a study of the properties of a system of quadrupole multiplets (closely grouped doublets or triplets) with 330-ft spacing. The properties of an idealized system of equally spaced converging lenses are described, providing a good approximation of the behavior of multiplets. Properties of closely grouped and spaced doublets and triplets are then derived. Numerical examples are given for all cases, and the transformation matrices are given in a form general enough to be applied to problems involving special lenses with tapered spacings and to misalignment and perturbation problems. Tables display switchyard transport admittances for several final beam energies and various quadrupole specifications. (D.C.W.)

**19422** (TID-18289) RAPID BEAM HANDLING SYSTEM OF THE ZGS MACHINE OR BEAM BUMPER JUMP TARGET SYSTEM. Theodore deParry (Argonne National Lab., Ill.). Dec. 19, 1962. Contract W-31-109-eng-38. 45p.

Design and operational principles of the rapid beam handling system to be used in the ZGS are discussed. A rise time of 20 μsec can be obtained for the magnetic field of the bumper system. Information on the maximum amplitude of radial oscillation of the beam for 35 revolutions around the machine and on various deflection angles of the beam is presented. Information on voltage, rise time, capacity, etc., relations is plotted. (D.C.W.)

**19423** (TID-18301) DIELECTRIC MEASUREMENTS ON THE RING MAGNET COILS. H. F. Vogel (Argonne National Lab., Ill.). Jan. 7, 1963. Contract W-31-109-eng-38. 15p.

Causes of failure of the dielectric in the ring magnet coils are briefly examined. Measures taken to prevent breakdown due to insufficient intrinsic dielectric strength and breakdown initiated by thermal runaway are described. The effects of gas discharges (ionization and atomic interactions) are discussed more fully, and a device and procedure for testing the dielectric against breakdown from gas discharge effects are explained. A voltage is applied between adjacent ring magnet conductors, and a detector that responds to the high-frequency spectrum of ionizing discharges is used. Raising the voltage to corona inception yields information on the percentage of voids in the dielectric. (D.C.W.)

**19424** (TID-18342) THE EFFECTS OF EDDY CURRENTS AND RESIDUAL FIELDS ON THE BETATRON OSCILLATIONS AT INJECTION. T. K. Khoe (Argonne National Lab., Ill.). Jan. 14, 1963. Contract [W-31-109-eng-38]. 8p.

The frequencies of betatron oscillations $\nu_x$ and $\nu_z$ were calculated for the ideal case of a uniform magnetic field in the octants; however, the gradient is not zero because of eddy currents and residual fields. Results of calculations for change of $\nu_x$ and $\nu_z$ as functions of d-c magnet setting are presented. (J.R.D.)

**19425** (TID-18345) EXTRACTION OF PROTON BEAMS FROM THE ZGS BY A RESONANT PULSED MAGNET. S. Suwa and A. Yokosawa (Argonne National Lab., Ill.). Jan. 9, 1963. Contract [W-31-109-eng-38]. 10p.

The characteristics of a proton beam extracted by the use of a resonant pulsed magnet and an energy-loss target are discussed. It is noted that this method is advantageous for beams with ejection times of 50 to 150 μsec. (J.R.D.)

**19426** (FTD-TT-63-68) AN ION SOURCE FOR PROTON-ACCELERATOR INJECTORS. Heinz Werner. Translated from U.S.S.R. Patent No. 146891. May 28, 1960. 6p.

Use of a radially magnetized permanent magnet with a single air gap having magnetic shunts to regulate the magnetic field of the lens provides a more reliable and serviceable ion source for proton-accelerator injectors. Such a magnet is described. (D.C.W.)

**19427** (JPRS-18505) THE BETATRON AT THE INSTITUTE OF ATOMIC PHYSICS OF THE RUMANIAN ACADEMY OF SCIENCES. C. Iliescu. Translated from Tehnica Noua, 9: No. 52, 1-3(Dec. 26, 1962). 4p. (OTS-63-21483)

Design and operation of the Rumanian betatron are briefly described, and its use in producing 25-Mev x rays for non-destructive flaw-detecting radiography is discussed. (D.C.W.)

**19428** (NP-tr-959) DETERMINATION OF OPTIMUM PARAMETERS OF DRIFT TUBES FOR CAVITY RESONATORS IN PROTON LINEAR ACCELERATORS. V. G. Andreev (Akademiya Nauk S.S.R. Radiotekhnicheskii Institut). Translated by R. Matthews (U.K.A.E.A. Atomic Energy Research Establishment, Harwell, Berks, Eng.) from report NT-4162-63. 1962. 12p.

Considerations involved in selecting the drift tube diameter for the cavity resonators of a proton linear accelerator are examined, particularly the relation of r−f losses to the drift tube dimensions and relative charged-particle velocity. Data are provided showing the r−f power that must be fed to a resonator for setting up the prescribed accelerating electric field strength along its axis as a function of the drift tube dimensions and the relative charged-particle velocity. The optimal drift tube dimensions from the standpoint of economic r−f power consumption for accelerating the particles can be selected from these data. (auth)

**19429** DESIGN CALCULATION AND PERFORMANCE OF LINEAR ACCELERATORS WITH A PROGRESSIVE WAVE. E. Petraşcu (Institutul de Fizica Atomica, Bucharest). Acad. Rep. Populare Romine, Studii Cercetari Fiz., 13: 501-22(1962). (In Rumanian)

The performance of a linear accelerator depends greatly on the operating requirements. If a very high-energy electron beam with a correspondingly low current is needed, the length of the tube must be increased considerably, resulting in low yields; in cases when the beam current must be high, as for the sterilization of foodstuff or the generation of fast neutrons, the ultimate value of the accelerating field is of little importance. It is concluded from the theoretical considerations presented that the reaction ratio is of great importance from the viewpoint of the energy gain and is one of the parameters influencing the yield of the accelerator. There is competition between the charge and the energy gained if the length of the system is increased, but this is more marked when a final external field is applied. It is recommended to design systems with low attenuation values and high series impedance. Short guide tubes present advantages when high charge and high yield are desired. (TTT)

**19430** THE ELECTRON INJECTOR OF THE BETATRON OF THE INSTITUTE OF ATOMIC PHYSICS, BUCHAREST. G. Baciu (Institutul de Fizica Atomica, Bucharest). Acad. Rep. Populare Romine, Studii Cercetari Fiz., 13: 695-703(1962). (In Rumanian)

In order to ensure an efficient injection of electrons into a betatron, the phase nonuniformity of the azimuthal and radial magnetic fields and the characteristics of the injection pulse must be improved. A new system, developed and used with success in the regular daily operation with the betatron of the Institute of Atomic Physics, permitted the injection of about 30-kev electrons with an emission current higher than 0.5 amp. The effective life of the cathodes was about 200 hours. The new control mechanism operated satisfactorily; the evacuated portion of the system was kept at a pressure below $10^{-6}$ mm of Hg. The following changes in the operational parameters are expected to result in further improvements in the electron injection system, e.g., increase of the injection voltage by a better treatment of the electrode surfaces thus reducing the potential gradient and making the system more rigid; this would result in the maintenance of the desired distance between the electrodes and the electron gun. Also, a more precise alignment of the electrodes, increase of the emission current by using oxide-type electrodes, and application of a focusing voltage and a constant voltage on the electron gun, changing the polarity repeatedly, are anticipated improvements. (TTT)

**19431** TOKYO INSTITUTE OF TECHNOLOGY 24 Mev ELECTRON SYNCHROTRON. Nobuhiro Yamamuro, Masatosi Odera, and Motoo Kondo. Bull. Tokyo Inst. Technol., Spec. No. 49, 53-68(1962). (In English)

Tokyo Institute of Technology 24 Mev electron synchrotron has been constructed to study the photonuclear reactions. The structure and properties of each part and the characteristics of $\gamma$ ray beam extracted from this synchrotron are described. (auth)

**19432** ANALOGUE STUDY OF A.V.R. CLOSE CONTROL OF ALTERNATOR SUPPLYING PROTON SYNCHROTRON PULSES. J. Switzman (English Electric Co. Ltd., Whetstone, Leics, Eng.). Elec. Times, 142: 675-80(Nov. 8, 1962).

In order to design the control of the alternators supplying proton synchrotron pulses for the required characteristics and accuracy, a study was performed on a DEUCE digital computer. The pulsing conditions of the load made it desirable that the ability of the regulator to meet the required performance should be checked by operating it with an analog of the alternator sets and rectifiers. The way in which the analog was built and the equipment used to represent each of the portions required are described. The results indicated that the automatic voltage regulators would perform their regulation within the specified duty limits. (M.C.G.)

**19433** DEBUNCHING OF THE BEAM PULSE FOR THE SYNCHROCYCLOTRON. Arata Suzuki (Tokyo Univ.). Japan. J. Appl. Phys., 2: 106-13(Feb. 1693).

A debuncher with half stochastic and half resonance acceleration was applied to the INS 160 cm synchrocyclotron. The resulting beam intensity was found to be almost unchangeable with time. The average beam current is 35% as large as it was before the debuncher was installed. (auth)

**19434** STABILIZATION OF A BETATRON OR SYNCHROTRON MAGNET EXCITATION. L. Sipek (Inst. of Vacuum Electronics, Czechoslovak Academy of Sciences, Prague). J. Nucl. Energy, Pt. C, 4: 417-18(Dec. 1962).

A betatron or synchrotron supply circuit was proposed that does not require an auxiliary stabilized source and uses the fact that the betatron or synchrotron magnet voltage-to-current characteristic is usually, or can easily be made, non-linear. In principle it is possible to use the magnet and condenser bank in parallel or in series. When connected in series the condenser bank corresponds in function to the linear impedance necessary for the stabilizing effect, and when the magnet and condenser bank are connected in parallel an auxiliary inductance, fulfilling the function of linear impedance, must be connected in series. Both circuits were successfully tested on the 15-Mev betatron and were practically equivalent. The stabilization coefficient obtained was 10-20. The stabilized magnet voltage was systematically observed and its fluctuation was lower than 2 per cent. (C.E.S.)

**19435** SPECTROMETER MAGNETS AND DETECTION APPARATUS USED. B. Milman (Ecole Normale Supér-

ieure, Orsay, France). Onde Elec., 42: 310-29(Apr. 1962). (In French)

Discussion is given on the extraction of electron beams of the linear accelerator at Orsay and the magnetic analysis of diffused or emitted particles by a target with the aid of electromagnets. Electronic optics is used to explain the behavior of spectrometers. General characteristics of spectrometers and double and triple focusing are also discussed. (P.C.H.)

**19436** MEASUREMENT OF THE INTENSITY OF THE CURRENT PRODUCED BY A LINEAR ACCELERATOR. D. Isabelle (Ecole Normale Supérieure, Orsay, France). Onde Elec., 42: 354-69(Apr. 1962). (In French)

A review is given on the 4 principal types of current measurements that can be used to determine the number of electrons furnished by the beam of a linear accelerator. Discussion is given on the Faraday cylinder, measurement of secondary electrons (M.E.S.), induction measurement, and the absolute measure of collected charges. The Faraday cylinder and secondary electrons measure the current with great precision. With the equipment used, it was confirmed that the Faraday cylinder allows the measurement with a precision of 0.5%. The efficiency of the M.E.S. with regard to the Faraday cylinder has a precision of 0.2%. However, if measurements are made on a time interval of several hours the variations of the efficiency of the M.E.S. can attain 1%. (P.C.H.)

**19437** BEAM EXTRACTION METHODS FOR SYNCHROCYCLOTRONS. Yu. Ya. Lembra. Usp. Fiz. Nauk, 79: 345-67(Feb. 1963). (In Russian)

Extraction of ion beams from a synchrocyclotron by an electric pulse deflector, multiple scattering on a target, a regenerative deflector, and by a no-magnetic channel method (where electric deflector extracts the beam after it passed a n = 1 area) was surveyed. An analysis was made of the methods used with various accelerators and the results are tabulated. 95 references are included. (R.V.J.)

**19438** TRANSVERSE STABILITY OF CHARGED BEAMS IN MAGNETIC RINGS. V. G. Grishin. Vestn. Mosk. Univ., Ser. III, Fiz. Astron., No. 6, 83-5(Nov.-Dec. 1962). (In Russian)

The density of particles and the effects of transverse instability of charged beams were studied for the case in which the transverse (radial) beam is considerably larger that other (vertical) beams. Linear oscillations of particles along the vertical beam and radial oscillations are assumed strong enough to cause nonlinear relations. (R.V.J.)

**19439** GEOMETRICALLY SIMILAR ORBITS IN CIRCULAR ACCELERATORS. Werner Heinz (Freie Universität, Berlin). Z. Angew Phys., 15: 89-92(Jan. 1963). (In German)

A general condition, which the magnetic guide field of a circular accelerator, especially an accelerator with a time-constant magnetic field and alternating gradients (FFAG accelerator), must fulfill so that the particle orbit in the symmetry plane of the magnetic guide field be geometrically similar for various particle pulses, is deduced. The field form that satisfies this condition was derived. The known fields for the FFAG radial sector type and the FFAG spiral sector type were found. Geometrically similar orbits are a sufficient condition for the frequency constant of the stabilizing oscillations of the particles in the given accelerators and therefore a criterion for its stability behavior. (tr-auth)

**19440** THE USE OF AN ELECTRONIC SIMULATOR FOR THE SOLUTION OF EQUATIONS OF LONGITUDINAL ELECTRON MOTION IN THE LINEAR ACCELERATOR. Yu. V. Ogorodov, I. K. Ogorodova, and A. V. Shal'nov. p.44-53 of "Uskoriteli, No. 3." Moscow, Gosatomizdat, 1962.

A universal simulator is described for the solution of equations of longitudinal particle motion in the buncher of a linear accelerator for a given change (along the accelerator axis) of the phase velocity of a wave and of the accelerating field amplitude. Difficulties arising in the simulation are considered, and a block diagram of the device is given. The results from the simulation of two versions of the problem, preliminarily computed on an electronic computer, are presented. As is shown, the error in determining the phase angle does not exceed 2%, while the maximum error in the energy determination is 3%. The principal merit of the apparatus is its simple readjustment for a new version. (Referativnyy Zhurnal, Fiziha, No. 10, 1962)

**19441** A BEAM DUCT FOR THE EXTERNAL ELECTRON BEAM OF A BETATRON. Eberhard Keil. Thesis, Wurzburg, Ger., Universität, 1961. 51p. $2.00; 8 DM.

The construction of an achromatic beam duct for the external electron beam of the betatron at the University of Wurzburg is described. The methods of quantitative planning for this project are discussed. The design for a 40° beam is given in detail. (Gmelin Inst.)

## Plasma Physics and Thermonuclear Processes

**19442** (AD-283512) THERMOPHYSICAL PROPERTIES OF PLASMAS. Final Summary Report, March 15, 1960–March 14, 1962. Richard C. Warder and Ali Bulent Cambel (Northwestern Univ., Evanston, Ill. Gas Dynamics Lab.). July 1962. Contract AF49(638)-879. 6p.

Characteristics and performance of the electromagnetic shock tube were studied, and the effects of radiation on the large attenuation of the shock wave velocity were examined and found unimportant for tubes of present density and velocity capabilities. Experiments at low densities with highly reflective walls show no observable radiation effects on shock velocity attenuation. Arc-jet plasma studies are being made. Apparatus and techniques were developed for spectroscopic measurement of the temperature distribution in a subsonic arc-heated plasma jet. Spectral intensity distributions for argon were measured and used to obtain a temperature distribution that ranged from 16,600°K at the jet axis to 10,000°K 1/8 in. away. Microwave apparatus and techniques for measuring electron density, electron collision frequency, and electrical conductivity of supersonic arc-heated plasmas were developed. Measurements were made on argon and nitrogen with 9 and 78 kmc microwaves, but the 9-kmc values were erroneous. Electron densities measured at higher frequencies agree well with theoretical predictions, but the electron collision frequencies differed from theoretical predictions. The infinite slab hypothesis used in many microwave plasma studies was satisfied. (D.C.W.)

**19443** (AD-283574) NONEXISTENCE OF PLASMA RESONANCE IN A COLD, SHARPLY BOUNDED PLASMA. W. Leavens (General Dynamics/Astronautics, San Diego, Calif.). Mar. 5, 1962. Contract AF19(604)-5554. 13p.

Planar electron oscillations in a cold, sharply bounded but otherwise uniform plasma is studied by the method of

Dawson. Multistreaming sets in very quickly and independently of amplitude, for those oscillations in which electrons pass outside the ion cloud, indicating that plasma resonance frequencies predicted by similar models are illusory. Such oscillations are allowed only if there is a harmonic oscillator potential just outside the ion cloud, and the single electron oscillator frequency is equal to the plasma frequency. (auth)

**19444** (AD-283577) AN EXPERIMENTAL STUDY OF THE ELECTROHYDRODYNAMIC WAKE BEHIND A CHARGED OBJECT IN A STREAMING PLASMA. T. Gooding, P. Harkins, and R. Lovberg (General Dynamics/Astronautics, San Diego, Calif.). Mar. 1, 1962. Contract AF19(604)-5554. 17p. (AE-62-0215)

The ion density behind a charged object in a streaming mercury plasma was studied, and the results confirm that an electrohydrodynamic wake is established. The ion density distribution in the wake suggests that direct scattering may overwhelm the collective effects discussed in the theory. (auth)

**19445** (AD-283830) EXCITATION OF PLASMA WAVES IN AN UNBOUNDED HOMOGENEOUS PLASMA BY A LINE SOURCE. Technical Report No. 373. S. R. Seshadri (Harvard Univ., Cambridge, Mass. Cruft Lab.). July 23, 1962. Contract Nonr-1866(32). 31p.

The radiation characteristics of a line source of magnetic current embedded in a homogeneous electron plasma of infinite extent are investigated for the case in which a uniform magnetic field is impressed externally throughout the medium in the direction of the source. The single-fluid theory of magnetohydrodynamics is employed. A very simple model is assumed for the plasma. Under this assumption, it is found that there are two modes of propagation of waves of small amplitude. By examining the behavior of these modes in the limiting cases of vanishing external magnetic field or infinite source frequency, they are identifiable as the modified forms of the usual plasma and optical modes which exist in an isotropic electron plasma. The dispersion relations for these two modes are discussed. The power radiated in each of the two modes is also evaluated. It is found that the power radiated in the optical mode is always lower than that owing to the line source in free space, whereas the power radiated in the plasma mode is higher than that value for certain ranges of the source frequency. (auth)

**19446** (AD-284381) SOME ASPECTS OF PLASMA ACCELERATION AND DIAGNOSTICS. Technical Report 3025. Lloyd M. Schack and S. S. Verner (Picatinny Arsenal. Feltman Research Lab., Dover, N. J.). Sept. 1962. 62p.

Methods of plasma propulsion are discussed, and an exposition of a variation of the rail device (the coaxial accelerator) is presented. Parameters necessary for accelerating a metal-derived plasma with an aggregate mass of one milligram to a velocity of $10^6$ cm/sec are established. In a discussion of plasma diagnostics, the techniques of Langmuir probes, the Mach-Zehnder interferometer, spectroscopy, and photography are presented. The diagnostic techniques primarily describe methods for obtaining plasma temperature and density. (auth)

**19447** (AD-284475) A STUDY ON THE RADIATION FROM ELEMENTARY DIPOLES IN A MAGNETO-IONIC MEDIUM. Chen Pang Wu (Ohio State Univ. Research Foundation. Antenna Lab., Columbus). Aug. 17, 1962. Contract AF33(616)-6782. 243p.

The electromagnetic radiation from electric and magnetic dipole sources in an unbounded gyroelectric plasma medium was studied. Also considered is the radiation from dipole sources in the presence of a grounded gyroelectric plasma slab. The problems are formulated by using the concept of modal analysis originally due to Arbel. Solutions which are valid everywhere can be expressed only in the form of integrals. In both cases, asymptotic expressions for the far-field approximation are obtained by the saddle-point method. 29 references. (auth)

**19448** (A&ES-62-1) THE CONSERVATION EQUATIONS OF A CLASSICAL PLASMA IN PRESENCE OF RADIATION. R. Simon (Purdue Univ., Lafayette, Ind. School of Aeronautical and Engineering Sciences). Feb. 1962. 32p. (N62-10486)

The conservation equations of a plasma are derived, taking into account the presence of radiation. Although the plasma is considered in the framework of classical gas dynamics, radiation is described as a relativistic photon gas. The 4-energy-momentum tensor of this gas is decomposed according to a process already used by Eckart in the case of a relativistic gas of material particles. The case of local thermodynamic equilibrium is also examined. (auth)

**19449** (CEA-2245) STRUCTURE DES COUCHES LIMITES DES PLASMAS CONFINES PAR DES CHAMPS MAGNETIQUES. (Structure of Boundary Layers of Plasmas Confined by Magnetic Fields). G. Laval and R. Pellat (European Atomic Energy Community and France. Commissariat à l'Energie Atomique, Paris). 1963. 32p.

The structure of a transition sheath between a magnetically confined plasma and vacuum is investigated. A one-dimensional, static solution of the collisionless Vlasov equation is sought. The two kinds of particles are assumed to have unequal masses, M− and M+, and temperatures, T− and T+; and the parameter $\lambda^2 = (M-/M+)(T-/T+) = (R-/R+)$ (R−, R+ are Larmor radii) is introduced. For non-relativistic particles, the result is obtained that no physical solution can exist except for $\lambda = 1$ without trapped particles. The problem for Maxwellian distribution functions, no charge separation field $\lambda = 1 + \alpha$ with $\alpha$ small, and with trapped particles, is investigated. For negative $\alpha$, only trapped ions are needed, and the distribution function of trapped particles that provides the thinnest sheath can be calculated. A complete solution of the problem with unequal masses, charge separation field, and trapped electrons is given. The sheath thickness is about four Larmor radii, a good physical picture if stable. (auth)

**19450** (IPPJ-2) MOTION OF ELECTRONS IN A MAGNETIC BOTTLE. Shuji Fukui, Satio Hayakawa, Tadao Honzawa, Hiroyuki Nishimura, and Haruo Obayashi (Nagoya, Japan. Univ. Inst. of Plasma Physics). Dec. 1962. 42p.

In order to investigate the motion of electrons as single particles, a magnetic bottle into which electrons are injected by an electron gun was constructed. The effect of scattering by gases on the mirror loss was mainly studied. Though the shadow effect of the gun was large, the fraction of electrons not colliding with the gun system could be distinguished from those that had collided by adopting the method of pulsed injection. The shadow effect was further eliminated by varying the pressure of a gas (He or Ar) in the chamber. The trapping time of injected electrons was deduced essentially from the intensity of slow electrons produced by their collisions with gas

atoms and was found to be accounted for in terms of single Coulomb scattering. The lifetime of the slow electrons can be qualitatively explained by their atomic scattering. (auth)

**19451** (JÜL-78-PP) STATIONÄRE PLASMAKONFIGURATIONEN IM MAGNETFELD. (Stationary Plasma Configuration in Magnetic Field). Karl Schindler (Kernforschungsanlage. Institut für Plasmaphysik, Jülich, Germany). Oct. 1962. 19p.

Equations were developed for describing a stationary cylindrical plasma in an axial magnetic field. The range of validity of the assumption of quasi-neutrality was determined. (M.C.G.)

**19452** (JÜL-79-PP) BESCHLEUNIGUNG VON PLASMA MIT EINER ELEKTRODENLOSEN KONISCHEN RINGENTLADUNG. (Acceleration of Plasma with an Electrode Gun Conical Ring Discharge). W. Bieger, H. Gresser, P. Noll, and H. Tuczek (Kernforschungsanlage. Institut für Plasmaphysik, Jülich, Germany). Dec. 1962. 26p.

The origin and properties of plasmoids from a conical electrodeless ring discharge were investigated. In addition to image converters, magnetic probes and loops and a counter-field spectrometer for determination of ion energies were used. The dependence of the initial density of the plasma in the discharge coil on two different emission mechanisms was established. At lower densities, if the ions could be considered free particles, for acceleration only the electromagnetic field at the beginning of the discharge was measured. At higher densities, if the plasma behaved hydromagnetically, for example, emission mechanisms were determined extensively by captured fields. Under certain initial conditions, a plasmoid originated with captured magnetic fields that remained steady over a time on the order of 10 $\mu$sec. (tr-auth)

**19453** (LAMS-2874) QUARTERLY STATUS REPORT OF THE LASL CONTROLLED THERMONUCLEAR RESEARCH PROGRAM FOR PERIOD ENDING FEBRUARY 20, 1963. (Los Alamos Scientific Lab., N. Mex.). Mar. 1963. Contract W-7405-eng-36. 34p.

Data revealed that electrons are trapped on the far side of the cusped field median plane from the plasma gun in Picket Fence II B. Small apparent scintillator persistence for $\tau \sim 100$ $\mu$sec and other difficulties interfered with analysis of particle energy, mass, and time behavior on escape from the cusp regions. Investigation continued with Picket Fence III to determine the mechanism by which electrons producing strong x rays at times $\gtrsim 20$ msec after injection were accelerated. Also at Picket Fence III an unsuccessful attempt was made to observe 3.02-Mev protons from d-d reactions. Persistence of x radiation for 40 ± 5 msec from the device was also noted. Modifications were made on the large bore gun that utilizes external injection of neutral gas. Deuterons were accelerated to ~170 kev. Cooling the center electrode was found to increase the yield, and studies revealed no simple relation between efficiency and cathode surface conditions. A Fabry-Perot interferometer operating at 35,000 Mc/sec was constructed, and its Q was measured by the ringing method as $6 \times 10^5$. The corresponding sensitivity for electron density measurement would be $10^7$ electrons/cm$^3$. A prototype plasma lens to focus high-energy pions was set up and tested. Peak currents of ~200 ka were obtained as was a ratio of focused to unfocused pions of ~7.35. Simple injection into a mirror machine was accomplished by firing a gun into one of the mirrors. Some plasma apparently was contained for a reasonably long time, but there was no clear evidence of neutron production from the plasma. Prototype field coils were constructed for transverse magnetic field injection experiments. Depolarization experiments measuring the effectiveness of a metal shorting sheet revealed a narrow conducting sheet in the stream direction to stop a slow plasma more readily than a fast plasma. Similarly, more effective stopping occurs at high-B field than at low-B field. Modifications were made to Scylla IV arrangement, and its preionizer was tested. Electron temperature was measured by a variety of methods. Steps to bring the temperature values into agreement were explored. Plasma electron density was determined from measurements of the Stark broadening of the Balmer $D_\delta$ line. Calculations showed the plasma to be fully ionized. The filling of Scylla I plasma with external field proved to be a false indication due to the presence of the plasma probe. Use of external magnetic probes solved the problem. A new high-speed framing camera for Scylla III was checked out, and modifications were made in the synchronization circuit and in the objective lens. Pictures of the Scylla III plasma were obtained. After improvements to the giant pulse laser, single giant pulses of up to 120 kw were obtained. Total Faraday rotation of the polarization plane by free electrons was also investigated. Capacitor and equipment development included modification of the Zeus megajoule, assembly of the Snap coil, discovery of unintentional alterations of the 50 kv ignitron configuration, proof of the value of castor oil as a capacitor impregnant, and assembly of a 30 kv ignitron test bank. (D.C.W.)

**19454** (MATT-137) THE EFFECT OF ION CORRELATIONS ON THE HIGH FREQUENCY CONDUCTIVITY AND EMISSION AND ABSORPTION COEFFICIENTS OF A FULLY IONIZED PLASMA. John Dawson and Carl Oberman (Princeton Univ., N. J. Plasma Physics Lab.). Aug. 1962. Contract AT(30-1)-1238. 15p.

The effects of ion correlations on the a-c conductivity of a plasma are studied. A general formula for the conductivity for an arbitrary fixed ion density distribution is given, and applied not only to the case of thermal equilibrium but also to situations where large ion fluctuations exist. In thermal equilibrium for frequencies low compared to the plasma frequency, the ion shielding reduces the maximum effective impact parameter by the factor $(1 + Z)^{\frac{1}{2}}$, and reduces the resistance arising from the excitation of longitudinal waves at frequencies near $\omega_p$ by the factor $1/1 + Z$. For frequencies large compared to $\omega_p$ there is no effect. However, if large amplitude ion fluctuations (non-thermal) exist, a possibility is found of greatly increasing the resistivity near $\omega_p$ through the enhancement of the longitudinal wave resistance. (auth)

**19455** (NP-12649) SOME PROPERTIES OF A HIGH CURRENT SPARK GAP. Rijnhuizen Report 63-07. P. C. T. van der Laan and A. de Jong (Stichting Voor Fundamenteel Onderzoek der Materie. Instituut Voor Plasma-Fysica, Jutphaas, Netherlands). Jan. 1963. 16p.

A triggered spark gap in air of atmospheric pressure was developed for use in a condenser bank. The spark gap switches a group of condensers with a total capacity of 31 $\mu$F and an energy of 5 kJ at a maximum voltage of 18 kv. A study of the delay of and jitter in the moment of breakdown was made to obtain reliable parallel operation of several spark gaps over a wide voltage range. Measurements indicate that in the voltage range in which the jitter is small, breakdown is initiated in the region of enhanced field in front of the trigger pin. Measurements of the spread in the spontaneous breakdown voltage at high cur-

rents show that brass is a suitable material for the electrodes and the trigger pin. (auth)

**19456** (NP-12651) SUMMARY OF SHERWOOD ACTIVITIES SUPPLEMENTARY REPORT. (Defense Atomic Support Agency. Field Command, Albuquerque, N. Mex.). Feb. 15, 1963. 41p.

The fast coaxial gun was operated in high and low pressure modes. The low pressure, high-energy mode was characterized by formation of two groups of deuterons — one about $10^{11}$ total, the other about $10^{16}$ ions/burst. E × B forces apparently accelerate the particles. The Scylla II preionizer produced a clean plasma with deuteron ion energies up to 800 ev. Scylla IV completion is reported; the preionizer and $B_0$ banks are in operation. Zeeman effect measurements revealed a 0 to 10 kgauss field in the fireball before peak compression. External probe measurements on Scylla I showed the external magnetic field to rise to 55 kgauss in 1.25 μsec with production of a hot deuterium plasma of $5 \times 10^{16}/cm^3$ density. X-ray measurements of temperature were also made. The flux of ions leaving the B field of Picket Fence III for various ion energies was measured. Modifications and x-ray experiments were done on Picket Fence II B. Plasma studies showed reflections to occur prior to sudden decay cut-bff at ~20 μsec. A large bore hydromagnetic gun was set up and showed reasonable neutron production. Experiments were also performed on coaxial gun injection into a magnetic field. Recent observations show the fraction of Lorentz force ionization in the fast neutral atom injection experiment, ALICE, to be much higher than previously supposed. The pulsed field coil system of the TOY TOP III S was rebuilt; neutrons were observed in subsequent operation. Efforts continued on reconciling the observed stability and the observed unstable plasma behavior of Table Top III with theory. A self-consistent solution for the distribution of electrons in an infinitely thin E-layer was derived analytically for the ASTRON now under construction. An elementary theory of the finite-conductivity problem was formulated and was found to fit experimental results. The 12-inch LEVITRON received new high-capacity vacuum pumps and a hollow-cathode-discharge plasma source. Homopolar V magnetic field coils, vacuum system, and valves were improved. Unsuccessful attempts to observe neutrons from d-d reactions were made. Limited operation of the Hothouse III ion cyclotron heating apparatus showed about 50% efficiency for power transfer from the oscillator to hydromagnetic wave motion. Characteristics of plasma established in the DCX-1 in carbon arc operation were examined. Currents, r-f activity intensity, plasma potential, and signals to neutral particle detectors were all analyzed. Operation of the almost complete DCX-2 revealed ion densities of about $10^7$ to $10^8/cm^3$ with hot-ion densities in the central field region of only $2 \times 10^6/cm^3$. Electron cyclotron heating experiments showed a large flux of kv neturons from the plasma apparently due to coulomb- or electro-dissociation of deuterium by high energy electrons. Studies revealed molten $LiF-BeF_2$ to be a promising material for thermonuclear reactor tritium blankets. Interaction between the electron beam and plasma in the electron-beam plasma injection experiment resulted in plasma electron heating. An electron temperature of 32 kev and a density of about $4 \times 10^{11}$ electrons/$cm^3$ were indicated. The C stellarator was operated using shaped pulses for ohmic heating. Microwave and relative line intensity monitoring were used in determining electron temperature and ion concentrations. Radiation and power loss balance, effect of helical windings on plasma behavior, plasma drift at U-bends, and effects of a transverse magnetic field were also studied. Neutral atoms produced during initial dissociation apparently remain for 5 to 8 msec. Wall impurities in the B-1 stellarator decreased when an aperture limiter was inserted. Magnetic pump equipment was added to the B-3 stellarator. Langmuir probe studies of current-voltage characteristics showed well-defined saturation current densities of ions and electrons in the ratio 1:30. Plasma losses were also studied. Ion energy distribution in B-66 was examined, and excitation of ion acoustic waves in highly ionized Cs and K plasmas by modulation of the potential of a W grid immersed in a plasma in the Or-3 device was noted. A device for studying transverse injection of plasma by a coaxial gun was constructed. Electron beam-plasma interaction experiments showed the power delivered to the beam under low vacuum conditions to be 11-30% less than for high vacuum. A net production from a fused lithium-BeF2 fusion reactor blanket was deemed possible. A study of the feasibility and merits of including fissile nuclides in a fusion blanket was investigated. Use of a laser beam for plasma diagnostics was examined. Efforts to alleviate temperature uncertainties and asymmetrical drift in the PHAROS coil were made. A 50 nanohenry, 50 kjoule portable capacitor bank was constructed. Experiments with the CHALICE device indicate that plasma bounce does not exist in high magnetic cusp fields. Research in the Federal Republic of Germany dealt with electrodeless acceleration of plasma and investigation of the theta pinch in a figure-8 stellarator. In the United Kingdom, a new method for estimating electron temperature of hydrogen plasma in the Zeta and cusped compression devices has been used successfully. Plasma behavior studies in Phoenix are also reported. In France deuterium plasma injected from an electrodeless gun into the Deca II mirror machine was investigated. (D.C.W.)

**19457** (RLE-TR-407) INVESTIGATION OF ELECTRON-BEAM INTERACTION WITH A BEAM-GENERATED PLASMA (thesis). Ward D. Getty (Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics). Feb. 20, 1962. Contracts DA36-039-sc-78108 and DA-SIG-36-039-61-G14. 113p.

The beam-plasma interaction is studied and considered as a possible mechanism for the heating of plasma electrons. A strong interaction between the electron beam and a weakly ionized gas is produced by a moderately high-permeance electron gun operating at peak pulse voltages up to 10 kv. The 3.5-μsec, pulsed electron beam is injected into an evacuated drift region from the magnetically shielded electron gun. The beam is confined by an axial magnetic induction of several hundred gauss. As it drifts to the collector, the beam partially ionizes the background gas (argon) in the drift region. After a time delay that is required for the production of plasma by beam ionization, self-excited uhf oscillations are observed. These oscillations are accompanied by several phenomena indicating that a strong interaction takes place. These phenomena are: scattering of the electron beam across the axial magnetic field by oscillatory, electric-field forces; generation of an intense pulse of visible light which occurs simultaneously with the beam scattering; and excitation of electrons to energies above 100 ev. Investigations of these phenomena are described and interpreted. An approximate small-signal theory of wave propagation in a cylindrical beam-plasma system is applied in the interpretation of certain properties of the plasma oscillations. Although their frequency varies rapidly with time, the oscillations

start at a frequency that is determined by the magnetic induction. The conclusion reached is that, in a beam-generated plasma system, the oscillations start at a frequency that is determined by the magnetic field and become sufficiently intense to impart a significant oscillatory energy to the plasma electrons. 58 references. (auth)

**19458** (RLE-TR-408) AXIAL FIELD EFFECTS IN A MAGNETICALLY DRIVEN SHOCK TUBE (thesis). William H. Heiser (Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics). Sept. 12, 1962. Contracts DA36-039-sc-78108 and DA-SIG-36-039-61-G14. 56p.

The effects of a uniform magnetic field normal to the shock front upon shock states and expansion wave properties were theoretically and experimentally investigated for large magnetic-drive fields. One-dimensional theory and several simplifying assumptions were employed to predict the important effects, and a method of visualizing the possible shock states was obtained. The restrictions upon shock-wave formation imposed by various types of instabilities were considered. A series of experiments was performed in a magnetically driven shock tube of annular cross section under conditions approaching the assumptions. Some difficulty was encountered in producing well-formed shocks, and a tentative link with the drive-current breakdown characteristics was established. Observations of well-formed shocks indicated close agreement with shock-transition theory, even when the axial magnetic field exceeded the switch-on value, although the expansion wave properties exhibited large departures from the theory. Some estimates of flow adjustments caused by radius effects and leakage through the boundary layer were made, and were found to contribute to an understanding of the experimental results. (auth)

**19459** (RT/FI(62)62) INTERFEROMETRIC MEASUREMENTS OF ELECTRON DENSITY GRADIENTS IN AN ORTHOGONAL PINCH. U. Ascoli-Bartoli and S. Martellucci (Italy. Instituto Sperimentale delle Ferrovie dello Stato, Rome). Dec. 1962. 14p.

Measurements of the electron density gradients in an orthogonal pinch by means of a grating interferometer are presented. The plots of the electron density gradients versus the radial coordinate are given at different times from the beginning of the discharge. (auth)

**19460** (SC-4776(RR)) SPECTROGRAPHIC ANALYSIS OF PLASMAJETS. Progress Report II. K. L. Shipley (Sandia Corp., Albuquerque, N. Mex. and Sandia Corp. Livermore Lab., Livermore, Calif.). Mar. 1963. Contract AT(29-1)-789. 33p.

Use of spectrographic techniques in plasma-jet diagnostics is described. Typical results of spectrographic data from argon and nitrogen plasma jets are included. For the argon jet, the results from line intensity measurements of ionized and unionized atoms generally give good information. However, results from hydrogen line broadening measurements indicate several unexplained discrepancies. For the nitrogen jet, the $N_2^+(0, 0)$ and $N_2^+(0, 1)$ bands from the first negative series were used to determine a rotational temperature. (auth)

**19461** (TID-18228) EXPERIMENTAL TRAJECTORY ANALYSIS OF CHARGED PARTICLES IN A CUSPED GEOMETRY. Special Report. James Sinnis and George Schmidt (Stevens Inst. of Tech., Hoboken, N. J.). [1962]. Contracts AT(30-1)-2813 and AT(30-1)-1921. 54p. (SIT-P82(1/63))

Electrons are injected axially from an external source into a cusp field. For particles to be transmitted through the cusp they must be injected inside a "loss disc" of radius $\rho_{critical} = (mv)/(qB_0)$. At larger values of the injection radius the depth of penetration beyond the median plane is measured and is in agreement with the maximum penetration depth predicted by the theory. The question of trapping is investigated, and no long time confinement is obtained. The maximum number of reflections observed inside the cusp region is five. 30 references. (auth)

**19462** (TID-18335) MEASUREMENTS OF B, E, AND n INSIDE THE SIMULATED GEOMAGNETIC-CAVITY-IN-THE-PRESENCE-OF-SOLAR-WIND. W. H. Bostick, H. Byfield, and M. Brettschneider (Stevens Inst. of Tech., Hoboken, N. J.). [1962]. Contract [AT(30-1)-2258]. 6p.

Measurements of the change produced in the magnetic field by the plasma stream at various positions in the midplane of the dipole were performed as a function of time for various upstream and downstream positions. These data which are taken for a plasma gun which turns the plasma stream on for ~15 μsec, clearly show that the magnetic field near the dipole on both the upstream and downstream sides is compressed. They also show the passage of the current sheet on the upstream side for distances of >6 cm from the dipole. Measurements of electric fields and ion density were performed with double probes and show that plasma actually does penetrate in the cavity, but penetration is delayed and signals show the rapid fluctuation characteristic of plasma vortices. Measurements of E and n within the cavity show that plasma leaks through the cavity wall in the form of isolated vortices or eddies and that these vortices penetrate deep into the cavity. The penetration of plasma from a region of low magnetic field to a region of high magnetic field in the form of vortices was observed. (H.G.G.)

**19463** (TID-18336) MEASUREMENTS OF AXIAL ELECTRIC FIELDS AND ION DENSITY IN THE COAXIAL PLASMA ACCELERATOR. W. H. Bostick, J. E. Nankivell, and W. Prior (Stevens Inst. of Tech., Hoboken, N. J. [1962]. Contract [AT(30-1)-2258]. 5p.

Measurements which provide evidence that plasma turbulence in magnetic fields is made up of vortices which circulate around the magnetic field lines are discussed. Evidence of vortices inside the simulated geomagnetic cavity formed by a plasma wind was also found. (J.R.D.)

**19464** (TID-18439) [PROGRESS REPORT ON RAIL GUN STUDIES], MARCH 1959–SEPTEMBER 1, 1959. Winston H. Bostick (Stevens Inst. of Tech., Hoboken, N. J.). Contract AT(30-1)-1921. 39p.

Previous research with rail guns is reviewed. Experiments indicated that curved rails confined plasma better than parallel plates or wires. The signals in some experiments indicated the presence of electrons rather than plasma, but acceleration of plasma with rail type equipment was achieved. During the period a second rail gun system that permits automatic or manual rail charging was placed in operation. One end of the rails was connected to the vacuum system while the other was connected to a lucite block. The arrangement is shown. Tests showed that variation of rail length had no effect on the Paschen curves relating length to breakdown voltage and pressure. The length and position of the discharge was somewhat dependent on gas pressure in the rails. Techniques developed for measuring plasma acceleration established only an average velocity for the conducting element of $7.2 \pm 2 \times 10^5$ cm/sec. Various types of probes were used to examine the properties of the discharge material. Results from flat disc probe tests indicate the propagating medium to be a negatively charged

medium with an excess of electrons, not a plasma. The shape of signals (displayed) from electric probes yielded the same conclusion, but a magnetic probe gave evidence for a plasma. An unsuccessful attempt was made to accelerate plasma injected by button guns. Measurements were made with Kerr cell photography and photocell arrangements. Time of flight and microwave Doppler shift measurements of the velocity agreed well. Some components for an acceleration arrangement using a button gun for a plasma source and a magnetic funnel for acceleration were completed. Low inductance switches for the fast 100,000 joule capacitor bank were tested, and a safety control system was added. Data and schematics of apparatus are presented. (D.C.W.)

**19465** (UCRL-10607) CONTROLLED THERMONUCLEAR RESEARCH SEMIANNUAL REPORT, JULY THROUGH DECEMBER 1962. (California. Univ., Berkeley. Lawrence Radiation Lab. and California. Univ., Livermore. Lawrence Radiation Lab.). Jan. 16, 1963. Contract W-7405-eng-48. 101p.

Investigations in Toy Top III were concerned mainly with transverse transport of plasma from the interior of the confining field across the magnetic field to the vacuum chamber walls. Gross cross-field transport was eliminated, and the reaction rate was found to have a decay constant of 50 to 70 $\mu$sec. Indeterminate measurements were made to correlate experimental results with finite ion orbit theory conditions for stability. Gas fed injector guns were constructed and operated, and an IBM 7090 program for magnetic-field calculations was completed. Work at Table Top III involved construction of a mechanical system to simulate rotating plasma and its utilization in rotating plasma form studies. Studies were also made to see if unstable plasma behavior in slow compression mirror machines occurred also for fast compression. Plasma experiments with ALICE included density measurements (maximum of $2 \times 10^8$ ions/cm$^3$), decay time measurements (0.61 sec maximum), r-f activity studies, and plasma potential measurements. Plasma oscillation studies revealed constant frequency during plasma decay in high magnetic fields. For lower fields, the frequency decays with the plasma. Cold plasma trapping experiments resulting in trapping of 15% of the beam for 200 $\mu$sec were performed. Calculations made by a finite orbit theory extension to mirror machine geometry indicated stable low-frequency oscillation modes that show frequency agreement with oscillations in ALICE. Finite orbit effects apparently play an important role over the whole range of interesting densities. Variation of two ion-source parameters increased the beam from 50 to 63 m amp. Analysis of plasma from the occluded-gas cold-plasma source included measurements of ion velocity, electron temperature, and density output. Amplifiers to be used in ALICE diagnostics were tested. Lorentz ionization of neutral hydrogen atoms using water vapor as the charge-exchange vapor was studied as a function of electric field and beam energy. Surface bombardment studies indicate that atomically clean high-mass metallic surfaces below 110°K will provide satisfactory walls for some high-purity plasma experiments. Compression and confinement measurements were made on a portion of the plasma column of the P-4 System, soon to be phased out of operation. The 700-kev electron gun and two of the six units of the Astron 5-Mev electron accelerator were operated. The 12-inch levitron and the 12-inch by 36-inch linear hard-core pinch were put into operation. In both cases, pinch formation at unusually low particle densities was found possible. Interesting equilibrium and instability phenomena were discovered. On the levitron, ultra-small-amplitude magnetic turbulence is observed and appears to be responsible for an anomalous energy drainage by hot-electron motion across the zero-order magnetic field. The theory of finite-resistivity hydromagnetic instabilities was developed further in a number of areas, notably the calculation of stability criteria for the tearing mode in cylindrical geometry. Experiments designed to observe the tearing mode in a Triax (reverse-$B_\theta$) pinch tube yielded satisfactory qualitative agreement with theory. Levitron diagnostic and vacuum equipment was also improved. Plasma research with Homopolar V was concerned primarily with developing diagnostic facilities. Conditions at the electrodes and the stability of the circular flow in rotating-plasma experiments were investigated theoretically using a simple macroscopic approach. Ion cyclotron resonance research was slanted toward development of diagnostic techniques. Determination of what happens to the cyclotron wave energy following resonant absorption is to be studied. The diagmagnetic effect of plasma as a function of axial probe position and of time was measured. Thermal pressure, ultraviolet radiation, electron temperatures, and impurity temperatures were also measured. Improvements made in the oscillator protective device permit reliable operation at full power. Ion density and electron temperature for a decaying hydrogen plasma in the Hothouse I experiment were obtained, and recombination rates derived from the data agree well with other calculations. Equipment for the study of hydromagnetic ionizing fronts was completed and preliminary measurements made. Flare effects that hindered optical and spectroscopic measurements in sheet pinch studies were eliminated. Plasma density and temperature were measured spectroscopically at times up to the third bounce. Lorentz ionization of neutral atoms and instability and oscillation in plasma columns were also examined. Helmholtz instability of two compressible fluids of equal density and infinite conductivity permeated by a magnetic field was investigated by normal mode analysis. Existence of a self-consistent electron distribution in the Astron E layer was investigated; a new method for treatment of finite Larmor-radius effects, applicable to mirror machine geometry, was devised. A new code for solving the Fokker-Planck equation for electron-velocity distribution in ALICE as a function of time was also written. Longitudinal oscillations in multi-component plasma with anisotropic velocity distributions were investigated, and solutions for ion density vs time in neutral injection mirror machines were calculated. Low-$\beta$ plasma stability in the Astron was examined. The electron gun and injection section for the bumpy torus were assembled; the measured magnetic field from the injection coils agrees well with theoretical predictions. Dissociation, dissociative recombination, charge exchange of ions and atoms, and scattering were also studied. Engineering and technological developments in ultrahigh vacuum, 2× multistage compression facilities, ALICE, Astron components and facilities, the bumpy torus, the cryogenic project, and various components are also reported. Electrical engineering developments on 2×, ALICE, the cryogenics-coil experiment, levitrons, energy storage systems, $\beta$-pinch capacitor banks, ignitrons, the Astron facility, the Astron accelerator, and the bumpy torus device are described. Microwave diagnostic equipment developed for and used with the Astron electron beam experiment, Toy Top, Levitrons, and the P-4 System are discussed; and work of the advanced applications group is described. A list of 59 publications and talks on pertinent subjects is included. (D.C.W.)

**19466** (ZPh-118) CERENKOV RADIATION IN A PLASMA. S. Rand (General Dynamics/Astronautics, San Diego, Calif.). Oct. 1, 1961. Contract AF19(604)-5554. 21p. (AD-283575)

A particle that traverses a low-density plasma, pervaded by a magnetic field, with a velocity considerably below the velocity of light in free space may emit Cerenkov radiation. A critical velocity, below which negligible Cerenkov radiation is emitted, is determined using the Appleton-Hartree theory. For a non-relativistic particle moving faster than this critical speed, the intensity of emitted radiation is estimated. It is found that a particle of unit electric charge traversing the ionospheric F layer with a velocity an order of magnitude below the velocity of light in free space will emit about 0.1 ev/sec. (auth)

**19467** (ZPh-133) A MECHANISM FOR REDUCING THE PROPAGATION VELOCITY OF RADIATION IN A PLASMA. S. Rand (General Dynamics/Astronautics, San Diego, Calif.). Dec. 1961. Contract AF19(604)-5554. 28p. (AD-283576)

A mechanism for the slowing down of radiation that propagates through the ionosphere is studied. Work is limited to propagation in the direction of the geomagnetic field, at a frequency that is not greatly displaced from the associated cyclotron frequency. The requirements for the wave to propagate over large distances, of the order of 1000 km, are presented. It is found that the mechanism is applicable only to high-power radiation, with a radiation field greater than 0.01 volts/cm, at altitudes above 300 km. With these conditions, the transverse wave may be slowed down by a factor of 50 below the free-space velocity of light. (auth)

**19468** (FTD-TT-62-1301) PROBLEMS OF MAGNETOHYDRODYNAMICS AND PLASMA DYNAMICS. [PART] II. PROCEEDINGS OF THE 2ND CONFERENCE ON THEORETICAL AND APPLIED MAGNETOHYDRODYNAMICS HELD AT RIGA, JUNE 27–JULY 3, 1960. Translation of Vopr. Magnitn. Gidrodinanm. i Dinam. Plazym, Tr. Konf., Akad. Nauk Latv. SSR, Inst. Fiz., Riga, 1960 (1962). 659p.

Abbreviated texts or abstracts for most of the 140+ papers presented at the conference are included. Problems in applied magnetohydrodynamics, experimental plasma physics, plasma theory, and theoretical magnetohydrodynamics are discussed. (D.C.W.)

**19469** (FTD-TT-62-1734) APPLICATION OF THE LANGMUIR PROBE METHOD FOR INVESTIGATING DEIONIZING PLASMA. V. A. Ivanchenko. Translated from Izv. Nauchn-Issled. Inst. Postoyah. Toka, No. 7, 5-13 (1961). 14p.

The probe characteristics of deionizing plasmas are noted to differ enough from those of fixed potential plasmas to make Langmuir's method for investigating deionization applicable only under certain conditions. The conditions and method for utilizing probe characteristics in determining the parameters (plasma potential, electron temperature, etc.) of a deionizing plasma are examined. A method for obtaining the probe characteristics of a periodically onsetting deionizing plasma is also described. (D.C.W.)

**19470** (MATT-Trans-3) EFFECT OF A STRONG MAGNETIC FIELD ON THE MAGNETOHYDRODYNAMIC STABILITY OF PLASMA AND THE RETENTION OF CHARGED PARTICLES IN A TOKAMAK APPARATUS. E. P. Gorbunov and K. A. Razumova (Akademiya Nauk S.S.S.R. Ordena Lenina Institut Atomnoi Energii). Translated for Princeton Univ., N. J. 1962. 36p.

The results of a study on the behavior of a plasma in strong, longitudinal magnetic fields up to 22 k gauss in a toroidal TM-2 unit are given. An increase in the magnetic field is shown to reduce considerably the low-frequency oscillation on oscillograms for the by-pass voltage and for the discharge current derivative and to also weaken the interaction of the plasma with the discharge chamber wall. Where a sufficiently high ratio exists between the intensity of the longitudinal magnetic field and the intrinsic current field, such oscillations do not develop. The electron density, in this case, hardly changes in the course of the process, while the conductivity attains a magnitude of about $10^{16}$ CGSE. (auth)

**19471** (MATT-Trans-4) COHERENT INTERACTION OF "RUN-AWAY ELECTRONS" IN A PINCH (COLUMN). V. A. Suprunenko, Ya. B. Fainberg, V. T. Tolok, E. A. Sukhomlin, N. I. Reva, P. Ya. Burchenko, N. I. Rudnev, and E. D. Volkov (Akademiya Nauk Ukr. S.S.R. Fiziko-Tekhnicheskii Institut, Kharkov). Translated for Princeton Univ., N. J. 1962. 13p.

Presented at the Proceedings of the Third Conference on Plasma Physics and on Problems of Controllable Thermonuclear Reactions.

An experimental investigation was made of electromagnetic radiation emission from a high-current discharge plasma with considerable electron runaway and with possibilities for the origin of beam instabilities. A correlation between the flow of runaway electrons and the radiation intensity was established, and the coherence of the radiation was verified by using an 8 mm interferometer to compare radiation phases from antennas along the plasma. Studies of radiation were made with a detector set to a wave length of 8.2 mm. The electromagnetic radiation intensity and power were found to be considerably larger than the intensity and power of thermal radiation. Investigation of the spectral composition of the radiation indicated that the maximum occurs for frequencies close to the plasma frequency. Coherent interaction of the runaway electrons with the plasma apparently leads to electrostatic plasma instabilities and the resultant emission of electromagnetic radiation with a frequency near the plasma frequency. (auth)

**19472** (MATT-Trans-5) STUDY OF INSTABILITY IN THE CYCLOTRON METHOD OF PLASMA HEATING. N. I. Nazarov, A. I. Ermako, V. T. Tolok, and K. D. Sinel'nikov (Akademiya Nauk Ukr. S.S.R. Fiziko-Tekhnicheskii Institut, Kharkov). Translated for Princeton Univ., N. J. 1962. 10p.

Presented at the Proceedings of the Third Conference on the Physics of Plasma and on the Problem of Controlled Thermonuclear Reactions.

Behavior of plasma being heated by ion cyclotron waves for various levels of the high-frequency power input was studied. Instability was found to appear when the high-frequency field energy supplied to the plasma was increased. The dependence of the appearance of instability on the pressure, the duration of the high-frequency pulse, and the magnitude of the power input were also studied. (auth)

**19473** MEASUREMENT OF STREAM VELOCITY IN AN ARC. I. Kimura and A. Kanzawa (Tokyo Univ.). AIAA (Am. Inst. Aeron. Astronaut.) J., 1: 310-14(Feb. 1963).

In electric arcs, there generally exists a considerable streaming of plasma caused by Lorentz forces generated by self-magnetic fields. The method of measurement of such streaming velocity is described. The arc used is a d-c thermal arc of 105 amp in argon at atmospheric pres-

sure. The temperature of the arc was measured by a spectroscopic method and by a thermocouple, and a temperature distribution ranging from 16,000 to 1500°K was obtained. The streaming velocity was evaluated by measurement of the drag of a small plate swept across the arc, using the result of the temperature measurement, the drag coefficient of the plate, and the calculated density and viscosity coefficient of the plasma. At a section 2 mm from the cathode, the evaluated stream velocity was 135 m/sec at the center and 25 m/sec at the edge of the arc column from cathode to anode. The error in measured temperature is estimated at less than 10%, and the error in the measured stream velocity is considered to be less than 17.5%, excluding the error due to some change of the arc discharge caused by inserting the drag measuring plate. (auth)

**19474** TRANSITION RELATIONS ACROSS OBLIQUE MAGNETOHYDRODYNAMIC SHOCK WAVES. Roy M. Gundersen (Illinois Inst. of Tech., Chicago). AIAA (Am. Inst. Aeron. Astronaut.) J., 1: 482-3(Feb. 1963).

It is shown that all flow quantities behind an oblique hydromagnetic shock wave may be expressed in terms of the flow quantities in front of the shock and three parameters, viz., the shock strength, one giving a measure of the applied field, and one giving a measure of the obliqueness of the applied field with respect to the shock front. The fluid under consideration is an ideal, inviscid, non-heat-conducting gas of infinite electrical conductivity with constant specific heat. (C.E.S.)

**19475** COLLECTIVE INTERACTIONS AND THE PROBLEM OF THE PREPARATION OF HIGH-TEMPERATURE PLASMA. E. K. Zavoiskii. At. Energ. (USSR), 14: 57-65 (Jan. 1963). (In Russian)

It is not considered sufficient any more to describe the plasma as a system of charged particles which interact pair-wise with each other, by means of Coulomb interaction; the importance of collective processes such as the interaction of charged-particle beams with plasma gained recognition. The formation of charged-particle beams in plasma under the influence of electromagnetic fields should be closely investigated because of their importance in the transfer of the energy of the external electromagnetic field to the charged particles. The experiments involved studies of the turbulent heating method, containment problems of the turbulently heated plasma in a magnetic trap, and the effect of the ion-beam instability in the case of turbulent heating of the electrons colliding with the plasma jet. It was concluded that the turbulent heating represents a simple method for preparing a plasma with a high electron temperature. (TTT)

**19476** CYCLOTRON INSTABILITY OF THE PLASMA IN THE OGRA. V. I. Pistunovich. At. Energ. (USSR), 14: 72-81(Jan. 1963). (In Russian)

Studies of the oscillations in a homogeneous plasma indicated that the stability of the system is increased by lowering the pressure. This problem was further investigated by examining the cyclotron instability of a homogeneous anisotropic plasma in large electric fields in the Ogra. Cyclotron frequencies of the molecular and atomal ions were used. It was found possible to create cyclotron instability in the Ogra; at least, no other explanation could be given to the anomalous dependence of the electrical field on the densities of the plasma at cyclotron frequencies. Existence of density waves in the plasma with various phase velocities may result in the heating of the electrons and their ultimate removal from the trap. The cyclotron instability may cause a bunching of the ions, causing a more effective interaction as a result of the nonlinear effect. On the other hand, the existence in the cyclotron waves of electric fields in perpendicular direction to the magnetic field may create a transversal drift of the ions, if the wave velocity is close to the ion velocity. (TTT)

**19477** SCREW AND FLUTE INSTABILITIES IN A LOW-PRESSURE PLASMA. B. Lehnert (Royal Inst. of Tech., Stockholm). At. Energ. (USSR), 14: 82-91(Jan. 1963). (In Russian)

Under certain conditions, plasma may be contained by a transversal magnetic field. If the plasma pressure is low with respect to the energy density of the magnetic field, the field is the same in the presence of plasma and in vacuum. A transversal motion of the plasma is theoretically impossible but other types of motion, not accompanied by a change of the magnetic field, may ultimately result in the escape of the plasma. Such cases, involving flute and screw instabilities were more closely examined; mechanisms involved in the formation of spatial charges, such as the gravitation-induced drift, centrifugal forces, inertia forces generated by magnetic pinch, and the effect of the Larmor radius. The results of the calculations indicated a strong interaction between the mechanisms corresponding to the flute and screw instabilities; these mechanisms are able to create instabilities in both partially and completely ionized gases. The theory developed is based on the equations of the macroscopic motion of the gas, as defined by the Boltzmann equation. (TTT)

**19478** THE THERMALIZATION PROCESS OF THE HIGH ENERGETIC CHARGED REACTION PRODUCTS IN THE FUSION REACTOR. M. Shindo, N. Ikeda, and Y. Ebizuka. Bull. Tokyo Inst. Technol., Spec. No. 49, 105-10 (1962). (In English)

An analytical study is made of the thermalization of energetic fusion products by multiple Coulomb collisions with plasma field electrons. The thermalization time is calculated by numerical integration. The geometrical loss of the charged particles is considered, and equations with dimensionless parameters are derived. (D.L.C.)

**19479** THEORETICAL STUDY OF THE FREE OSCILLATING MOVEMENT BETWEEN TWO INFINITE PARALLEL VERTICAL PLANES OF A COLUMN OF HEAVY, VISCOUS, AND ELECTROCONDUCTING LIQUID IN THE PRESENCE OF A MAGNETIC FIELD. Étienne Crausse, Yves Poirier, and Charles Vivés (Faculté des Sciences, Algiers). Compt. Rend., 256: 886-9(Jan. 21, 1963). (In French)

A theoretical study was made of the free oscillations between two infinite, parallel, vertical planes of a heavy, viscous, electroconducting fluid column exposed to a magnetic field normal to the planes. The basic parameters are derived. Theoretical curves for some values of these parameters are presented. (tr-auth)

**19480** EXPERIMENTAL VERIFICATION OF PHENOMENA CONNECTED WITH THE PROPAGATION OF WAVES CIRCULARLY POLARIZED TO THE RIGHT IN A HOT PLASMA. Térenzio Consoli, Georges Ichtchenko, and Micheline Weill. Compt. Rend., 256: 903-6(Jan. 21, 1963). (In French)

The phenomena connected to wave propagation, in the vicinity of cyclotron resonance, in a hot and not very dense plasma were described and interpreted. The phenomena studied were effect of a wave guide, displacement and length variation of the cyclotron resonance ray, and density increase at cyclotron resonance. These phenomena were studied theoretically earlier (Compt. Rend., 255: 2394 (1962)). (J.S.R.)

**19481** VARIATION IN POTENTIAL ENERGY AND VARIATIONAL PRINCIPLES CONCERNING THE EQUILIBRIUM AND STABILITY OF A HOT PLASMA IN A STRONG MAGNETIC FIELD. Jean Andreoletti (Centre d'Etudes Nucléaires, Saclay, France). Compt. Rend., 256: 1251-4 (Feb. 4, 1963). (In French)

For the consideration of probability distributions on magnetic lines, a very direct dynamic demonstration was given of the potential energy variation; two variational principles on the equilibrium and stability, as well as a limited principle relative to the stability of a low pressure plasma, were deduced. (tr-auth)

**19482** SOME APPLICATIONS OF UHF TO THE DIAGNOSTICS OF IONIZED GASES. A. Neyron (Centre d'Études Nucléaires, Saclay, France). Ind. At., 6: 87-98 (1962). (In French)

Two types of uhf interferometers for the determination of the electron density of a gas are described. The first is a relatively slow, but precise, apparatus using the retroaction principle (controlled interferometry). On the contrary, the second apparatus permits, in a relatively short time interval ($\Delta t = 0.5\ \mu$ sec), the analysis of the state of the relatively long phenomenon (10 to 20 $\mu$ sec). This functioning is obtained by producing fringe modulation trains from which the relative position is observed. (tr-auth)

**19483** PLASMAS AND PHOTOCHEMISTRY. C. A. Papp (Plasmadyne Corp., Santa Ana, Calif.). Ind. Eng. Chem., 55: 48-9(Apr. 1963).

The Vortex Stabilized Radiation Source is described. The source is essentially a plasma jet enclosed in a transparent envelope. By proper choice of the working gas and operating conditions, intense radiation can be produced within the range of wavelengths useful for photochemistry. Power level can be several times that of available lamps. The equipment has shown its potential in polymerization. An additional application may lie in intense lamps that simulates sunlight for artificial aging of materials and photocopying. (C.E.S.)

**19484** HELICAL INSTABILITY OF A LINEAR DISCHARGE PLASMA PRODUCED BY A LARGE CAPACITY CONDENSER BANK. Hiroshi Enjōji and Kousuke Okamoto (Inst. of Physical and Chemical Research, Tokyo). Japan J. Appl. Phys., 2: 114-20(Feb. 1963).

Helical instability of a linear discharge plasma produced by an electrolytic condenser bank is investigated with a streak camera. The capacity and the working voltage of the bank are $1.1 \times 10^4$ $\mu$f and 500 volts respectively. The process of formation of the helical plasma is observed. The formation of the helix started about 20 $\mu$sec after the initiation of discharge, and the helix rotates with an angular velocity of several degrees per microsecond. The validity of Shafranov's condition for a stable plasma is experimentally verified. Regular ripples superimposed on the wave forms of the voltage and current pulses corresponded to the rotation of plasma stripes. (auth)

**19485** VIBRATIONS OF A CONFINED CYLINDRICAL PLASMA ABOUT A GAUSSIAN EQUILIBRIUM DENSITY DISTRIBUTION. Richard L. Moore (Moore Applied Physics Co., Los Angeles). J. Electron. Control (1), 14: 1-20(Jan. 1963). (In English)

A fully ionized, bounded, cylindrical plasma with a gaussian equilibrium density distribution was assumed. Equations of conservation of energy and of pressure change were obtained. An equation of radial vibrations were obtained without linearization. Analytic solutions for standing waves to this equation were found in terms of the confluent hypergeometric function. The fundamental frequencies for radial standing waves were found to be $C/\pi\sigma\sqrt{2}$ for ion sound waves and $C_e/\pi\sigma\sqrt{2}$ for electronic sound waves. C is the plasma ion sound speed, $C_e$ is $(\gamma RT)^{\frac{1}{2}}$ evaluated for the electron gas, and $\sigma$ is the standard deviation of the density distribution. Conditions for the plasma to be stable (i.e., to remain at rest) were found. (auth)

**19486** LABORATORY OBSERVATIONS OF THE LUXEMBOURG EFFECT IN FREE SPACE PLASMA COLUMNS. Thaddeus Kaliszewski (Sylvania Electric Products, Inc., Waltham, Mass.). J. Electron. Control (1), 14: 81-90(Jan. 1963). (In English)

A diagnostic technique useful in the study of electron loss processes in gaseous discharges is discussed. This technique, based on the Luxembourg effect, is especially advantageous in situations where the size, the geometry, or the nature of plasma formation prevents the use of enclosures such as a cavity or a waveguide. In its present form the technique is best employed in conjunction with the Langmuir probe or, when possible, with the microwave interferometer, whose functions it supplements. Observations using this technique were made in the afterglow of an electrical discharge in neon, nitrogen, and dry air. Measurements of energy relaxation constants allow the determination of the effective electron collision frequencies and of the effective collision cross section, provided that the electron temperatures can also be determined. (auth)

**19487** THE SCEPTRE IV TOROIDAL DISCHARGE. N. L. Allen, D. Balfour, V. C. Cloke, et al. (Associated Electrical Industries, Ltd., Aldermaston, Berks, Eng.). J. Nucl. Energy, Pt. C, 4: 375-90(Dec. 1962).

A review is given of the main experimental results obtained with the Sceptre IV discharge. The torus was toroidally machined from high quality copper and has an initial magnetic field accurately matched to the tube wall. With capacitor bank energies up to $10^6$ J, discharge currents up to 500 kamp were studied. Many of the properties of the discharge, including the electron temperature, the average magnetic field profiles, and the fusion reaction rates are similar to those obtained with other experiments (Zeta, Sceptre IID), there being no appreciable change in these properties with either the improved geometrical shape or with the increase in energy. Differences from the earlier experiments include larger magnetic field fluctuations, less reproducibility, somewhat lower ion temperatures (Doppler broadening), and a different radial profile for the ion temperature. These differences are possibly due to the magnetic fields generated at the gaps by eddy currents when the gas current is flowing. New measurements include a study of the $\theta$ as well as $\phi$ motion of the reacting deuterons and a new method of measuring the electron temperature. A summary is given of the theories that have been put forward to explain the electron energy loss, the positive ion heating, and the magnetic field profiles. (auth)

**19488** ON INTEGRATING THE VLASOV EQUATION. T. K. Fowler (Oak Ridge National Lab., Tenn.). J. Nucl. Energy, Pt. C, 4: 391-4(Dec. 1962).

A first step in analyzing the stability of solutions of the Vlasov equation governing hot plasmas of low density is to solve the linearized equation for the perturbed space and velocity distribution function in terms of the perturbed electric and magnetic fields. An explicit Green's function solution for the distribution is presented together with two samples of its use. The Green's function is found by first transforming to equilibrium constants of motion as variables. (auth)

**19489** GENERATION OF HARMONICS OF THE ELECTRON-GYROFREQUENCY IN A PENNING DISCHARGE. G. Landauer (Max-Planck-Institut für Physik und Astrophysik, Munich). J. Nucl. Energy, Pt. C, 4: 395-400(Dec. 1962).

A summary is given of the experiments on emission of electron-gyrofrequency harmonics from a cold P.I.G. discharge in helium. This emission was detected by microwave receivers operating in the 10 and 35 kmc/s bands. Harmonic emission up to a number of $m \simeq 25$ was obtained by varying the external magnetic field. Details of pressure and time dependence of the harmonic emission are given. Hypothetical assumptions for an explanation of the experiments are discussed. (auth)

**19490** ROTATION AND INSTABILITY OF PLASMA IN FAST $B_z$ COMPRESSION EXPERIMENTS. J. B. Taylor (Culham Lab., Abingdon, Berks, Eng.). J. Nucl. Energy, Pt. C, 4: 401-7(Dec. 1962).

The phenomena of rotation and subsequent instability of plasma in fast compression (theta-pinch) devices are discussed in the light of present stability theory including finite Larmor radius effects. For the rotation to be unstable the plasma must possess an angular momentum exceeding that appropriate to the ion diamagnetic current and it is suggested that this is acquired as a result of a secondary process occurring as the plasma leaves the wall. It is shown that when this process is taken into account the theory is adequate to explain most observed phenomena and suggests others that might be investigated. In the Appendix the theory of finite Larmor radius stabilization is interpreted in terms of a hydrodynamic picture. This analysis is not rigorous but does suggest that the stability criteria, originally derived for a specific model, might have more general validity. (auth)

**19491** PRELIMINARY SPECTROSCOPIC RESULTS ON A VERY LONG, HIGH-CURRENT, MAGNETICALLY CONFINED, VACUUM CARBON ARC. J. R. McNally, Jr., M. R. Skidmore, J. E. Francis, P. M. Jenkins, and D. A. Griffin (Oak Ridge National Lab., Tenn.). J. Opt. Soc. Am., 53: 495-6(Apr. 1963).

Spectroscopic study of a 194 in. long Luce arc operated with carbon electrodes in a magnetic field varying from 2800 to 8300 gauss indicated a maximum ion temperature of 430 ev, believed to be the hottest, high-density, steady-state ion plasma achieved in a laboratory. The ratio of temperature determined from transverse viewing to that from axial viewing was close to unity near the anode but increased significantly at great distances from the anode. (D.C.W.)

**19492** INTERFERENTIAL SPECTROMETRY OF PLASMAS FROM 0.1 TO 10 mm. R. Papoular (Euratom-CEA, France). J. Phys. Radium, 23: Suppl. No. 12, 185A-92A(Dec. 1962). (In French)

A Boltzmann interferometer was built and used as a spectrometer for studying the emission of several sources in the band between 0.1 and 10 mm wavelength. Reasons are given for the choice of this technique and the different steps of the design are discussed. Best working conditions (slit width, filters, and time constant) were found by computation and experiment. Finally experimental results are given and discussed. (auth)

**19493** FLUCTUATIONS IN A PLASMA. III. EFFECT OF THE MAGNETIC FIELD ON THE STOPPING POWER. Naobumi Honda, Osamu Aono, and Taro Kihara (Tokyo Univ.). J. Phys. Soc. Japan, 18: 256-60(Feb. 1963).

The rate of energy loss of a fast charged particle moving through a plasma in a magnetic field is obtained exactly without any cut-off procedures. The stopping power decreases as the magnetic field is increased. Some limiting cases are treated analytically, but general cases are investigated with numerical calculations. (auth)

**19494** SOME EXPERIMENTS ON PROBE CHARACTERISTICS IN DRIFTING PLASMA. Toshihiko Dote (Nippon Telegraph and Telephone Public Corp., Tokyo), Torao Ichimiya, and Fumio Tamaki. J. Phys. Soc. Japan, 18: 260-5(Feb. 1963).

An experimental work is presented to examine a previous analysis for the estimation of positive ion density in the ionosphere from the ion current obtained by a rocket-borne Langmuir probe. The plasma was formed in a low-density supersonic wind tunnel, where the probe characteristics were measured. The drift Mach number, pressure, and temperature of the plasma were 3, 86 microns Hg, and 107°K respectively. It is indicated that the values of positive ion density estimated by the previous analysis are nearly equal to the values of electron density obtained from the electron saturation current characteristics that are considered to be almost independent of the supersonic drifting of plasma. (auth)

**19495** RESONANCE DENSITIES IN A CYLINDRICAL PLASMA COLUMN. Adam Dattner (Royal Inst. of Tech., Stockholm). Phys. Rev. Letters, 10: 205-6(Mar. 15, 1963).

Interaction between an electromagnetic wave and a cylindrical plasma give rise to a resonance spectrum with a series of peaks at which the wave is strongly scattered. A measurement of the electron densities at which the resonances occur is given. A plasma-filled glass tube is situated in a waveguide with its axis perpendicular to the electric field and to the direction of propagation. A cylindrical microwave cavity is used to determine the density in terms of the mean square plasma frequency in the plasma. (C.E.S.)

**19496** RESONANCE OSCILLATIONS IN A HOT NONUNIFORM PLASMA. Peter Weissglas (Swedish State Power Board, Vällingby, Sweden). Phys. Rev. Letters, 10: 206-8 (Mar. 15, 1963).

Hydrodynamic equations and a simple model for the density variation are used to examine resonance oscillations in a hot nonuniform plasma. (C.E.S.)

**19497** DISPERSION EQUATION TAKING INTO ACCOUNT WAVE MAGNETIC FIELD FOR ORDINARY WAVE. W. P. Gorkov. Vestn. Mosk. Univ., Ser. III, Fiz. Astron., No. 6, 28-31(Nov.-Dec. 1962). (In Russian)

Dispersion equations for ordinary waves, considering the effects of wave magnetic field, are developed for an arbitrary electron distribution in plasma. (tr-auth)

**19498** THERMOMAGNETIC WAVES AND EXCITATION OF A MAGNETIC FIELD IN A NONEQUILIBRIUM PLASMA. L. E. Gurevich (Ioffe Inst. of Physics and Tech., Academy of Sciences, USSR). Zh. Eksperim. i Teor. Fiz., 44: 548-55(Feb. 1963). (In Russian)

It is shown that in a plasma with a temperature gradient, magnetic fields arise during hydrodynamic motions that are capable of resonance acceleration of the electrons and ions. In a plasma of this type a special type of thermomagnetic waves may exist; the Alfven wave splits into two waves with different frequencies, and the spectrum of the magnetoacoustic waves is modified. (auth)

**19499** TURBULENT THEORY OF A WEAKLY NONEQUILIBRIUM RAREFIED PLASMA AND THE STRUCTURE OF SHOCK WAVES. A. A. Galeev (Galyeyev) and V. I. Karpman (Novosibirsk State Univ., USSR). Zh. Eksperim. i Teor. Fiz., 44: 592-602(Feb. 1963). (In Russian)

A kinetic equation is derived for interacting waves in a

weakly nonequilibrium rarefied plasma. The relation between the laminar and turbulent theories of shock waves "without collisions" in a magnetic field is discussed. An estimate of the turbulent width of shock waves is made on basis of the kinetic equation. (auth)

**19500** NONLINEAR THEORY OF THE INTERACTION OF "MONOENERGETIC" BEAMS WITH A PLASMA. V. D. Shapiro (Inst. of Physics and Tech., Academy of Sciences, Ukrainian SSR). Zh. Eksperim. i Teor. Fiz., 44: 613-25 (Feb. 1963). (In Russian)

A nonlinear theory of the oscillations excited by the interaction of "monoenergetic" beams with a plasma is considered. The amplitudes of the oscillations during the saturation stage, and the increase of the thermal energy of the beam and plasma as a result of the interaction under consideration, are determined. (auth)

**19501** ÜBER ARBEITEN ZUR HYDROMAGNETIK ELEKTRISCH LEITENDER FLÜSSIGKEITEN, ÜBER VERDICHTUNGSSTÖSSE UND AUS DER HOCHTEMPERATURPLASMAPHYSIK. (Works on Hydromagnetics of Electrically Conducting Fluids and on Compression Shocks and on High Temperature Plasma Physics). Wilhelm Fucks. ERZEUGUNG VON PLASMA HOHER TEMPERATUR DURCH MAGNETISCHE KOMPRESSION. (Production of High Temperature Plasma by Magnetic Compression). Hermann L. Jordan. Cologne and Opladen, Westdeutscher Verlag, 1962. 92p. (JÜL-87-PP)

I. The hydromagnetic theory of bearings is discussed. The hydromagnetic case of a flow between two plane plates slightly inclined toward each other was calculated. The results were applied to the case of the flow of an electrically conducting fluid in a cylindrical bearing. Similarity laws were derived. Magnetically driven shocks of high values of the Mach number are discussed. The planarity of the luminous front was studied by streak-camera photographs. The velocity of the luminous front as a function of the distance from the shock-generating coil and of the initial pressure was measured. Precursor signals and the electron temperature immediately behind the luminous front were measured with the help of time resolved spectroscopy. Some of the experiments in high-temperature plasma physics are described and the status of these experiments with regard to an experiment with positive energy balance was evaluated. It was concluded that with the help of theta-pinch a plasma with densities of some $10^{17}$ $l/cm^3$ and a temperature of about 1 kev can be generated and kept stable for microseconds. II. Methods are described that allow the production of fully ionized plasmas isolated from material walls, with extremely low impurity content at high densities and with temperatures of several million degrees centigrade or with directed velocities up to 40 cm/μsec. The plasma is produced in consecutive steps: radiofrequency preionization that produces a weakly ionized electrically conducting gas; superposition of a slowly varying magnetic field in order to produce an internal magnetic field of given polarity and intensity; preheating by a high-power electrodeless discharge that produces a fully ionized, magnetically isolated plasma of about 30,000° with trapped internal magnetic field; and shock-heating and adiabatic compression by a fast-rising external magnetic field, which, depending on geometry of the field-producing coils, either heats the plasma to temperatures of millions of degrees or accelerates the plasma to high directed velocities. (auth)

**19502** RELAXATION OF PHOTONS AND PLASMA ELECTRONS IN A STRONG MAGNETIC FIELD. S. V. Peletminskii (Peletminsky) (Inst. of Physics and Tech., Academy of Sciences, Ukrainian SSR). Zh. Eksperim. i Teor. Fiz., 44: 735-43(Feb. 1963). (In Russian)

Relaxation of plasma electrons and of the photons emitted by them as a result of radiative processes in a strong magnetic field is studied. The time variation of the photon distribution function and mean transverse electron energy in the relativistic case is derived. During the photon relaxation time the mean transverse electron energy practically reaches its stationary value, whereas the photon distribution function approaches a Jeans-Rayleigh distribution. For periods $t > \tau$ ($\tau$ = relaxation time constant), the electrons relax (with a constant mean transverse energy) toward a Maxwellian distribution. (auth)

**19503** ZEUS TRANSMISSION SYSTEM COAXIAL HEADER (Engineering Materials). (Los Alamos Scientific Lab., N. Mex.). 8 units (containing drawings). (CAPE-928)

The thermonuclear magnetic compression experiment, Scylla IV, is designed to use the zeus transmission system as the secondary capacitor bank. A system of cable isolation was developed in order to eliminate the fuses, parallel plate lines, and the source inductance. A low-inductance cable is connected with each capacitor on a shelf and to a coaxial switch header. The coaxial header has an inherently low inductance geometry and is used in switching each of the 7 shelves of the zeus secondary capacitor bank. (F.E.S.)

**19504** THERMONUCLEAR DEVICE—AUXILIARIES (Engineering Materials). (Los Alamos Scientific Lab., N. Mex.). 5 units. (CAPE-929)

Drawings showing two ignition housings and a capacitor are presented. These are used in thermonuclear devices. One of the ignitron housings has an oil-filled long-skin bag. Its base flange is $6\frac{1}{2}$ in. in diameter and the housing is 3 in. in diameter and 12 in. high. The other ignitron housing is oil filled with a folded return. Its base flange and housing diameters are the same as the other but it is only 9 in. high. The 25 kv 5 μf capacitor is contained in a can, 25 in. × 14 in. × $7\frac{1}{4}$ in. (F.E.S.)

**19505** HIGH CURRENT RADIO FREQUENCY ION SOURCE. Mohamed E. Abdelaziz (to U. S. Atomic Energy Commission). U. S. Patent 3,084,273. Apr. 2, 1963.

This patent relates to a high current radio frequency ion source. A cylindrical plasma container has a coil disposed around the exterior surface thereof along the longitudinal axis. Means are provided for the injection of an unionized gas into the container and for applying a radio frequency signal to the coil whereby a radio frequency field is generated within the container parallel to the longitudinal axis thereof to ionize the injected gas. Cathode and anode means are provided for extracting transverse to the radio frequency field from an area midway between the ends of the container along the longitudinal axis thereof the ions created by said radio frequency field. (AEC)

**19506** APPARATUS FOR TRAPPING ENERGETIC CHARGED PARTICLES AND CONFINING THE RESULTING PLASMA. Gordon Gibson, Willard C. Jordan, and Eugene J. Lauer (to U. S. Atomic Energy Commission). U. S. Patent 3,085,173. Apr. 9, 1963.

The present invention relates to a plasma-confining device and a particle injector therefor, the device utilizing a generally toroidal configuration with magnetic fields specifically tailored to the associated injector. The device minimizes the effects of particle end losses and particle drift to the walls with a relatively simple configuration. More particularly, the magnetic field configuration is

created by a continuous array of circular, mirror field coils, disposed side-by-side, in particularly spaced relation, to form an endless, toroidal loop. The resulting magnetic field created therein has the appearance of a "bumpy" torus, from which is derived the name "Bumpy Torus." One of the aforementioned coils is split transverse to its axis, and injection of particles is accomplished along a plane between the halves of such modified coil. The guiding center of the particles follows a constant magnetic field in the plane for a particular distance within the torus, to move therefrom onto a precessional surface which does not intersect the point of injection. (AEC)

**19507** ENERGY-TRANSFER SYSTEMS. Peter Clive Thonemann, William Thomas Cowhig, and Philip Alan Davenport (to U. S. Atomic Energy Commission). U. S. Patent 3,085,189. Apr. 9, 1963.

This patent relates to the transfer of energy in a traveling electromagnetic wave to direct-current electrical energy in a gaseous medium. The traveling wave is generated by means of a radio-frequency oscillator connected across a capacitance-loaded helix wound around a sealed tube enclosing the gaseous medium. The traveling wave causes the electrons within the medium to drift towards one end of the tube. The direct current appearing across electrodes placed at each end of the tube is then used by some electrical means. (AEC)

## Shielding

*Refer also to abstracts 18378, 18379, 18382, 18383, 18384, 18388, 18389, 18390, and 18391.*

**19508** (ANL-6664) TESTING OF CONTAINMENT CAPABILITIES OF REINFORCED CONCRETE-SHIELDED ENCLOSURES. S. H. Fistedis, A. H. Heineman, and M. J. Janicke (Argonne National Lab., Ill.). Mar. 1963. Contract W-31-109-eng-38. 43p.

A reinforced concrete-shielded enclosure intended to contain nuclear reactor experiments was subjected to internal pressures up to 10 psig. The strains in reinforcing steel were measured with strain gages at critical locations for each pressure increment. These strains were compared with calculated strains; good agreement was found if the appropriate stress-concentration factors are applied at locations near re-entrant corners and wall openings. Leakage-rate tests were performed to disclose the ability of an ordinary thick-walled concrete cell to contain compressed gases. Observed leak rates are given for the two twin cells, before and after the inside surfaces were painted. (auth)

**19509** (NAA-SR-Memo-5001) PHOTON STREAMING AROUND OFFSET CYLINDRICAL AND SQUARE ACCESS PLUGS IN THICK SHIELDS. W. A. Rhoades (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Mar. 3, 1960. Contract [AT-11-1-GEN-8]. 21p.

Equations for three separate contributions to photon streaming (radiation scattered across the offset and streaming through the annular sections located above and below the shield offset) are developed. Streaming from the annulus above the offset is the dominant contribution in the case of a 4 in. cylindrical plug in a 42 in. magnetite concrete shield. Radiation scattered across the offset is found unimportant in this case. For a 1.8 Mev source, optimum location of the offset would reduce the maximum streaming dose rate to one half that obtained with the offset located at the midplane. (auth)

## Theoretical Physics

**19510** (TID-18344) THE RESEARCH PROGRAM IN THEORETICAL PHYSICS AT THE PUPIN LABORATORY. Annual Progress Report, February 16, 1962–February 15, 1963. Robert Serber (Columbia Univ., New York). Mar. 15, 1963. Contract AT(30-1)-1934. 15p.

A description is given of experimental and theoretical studies of elementary particle interactions. (T.F.H.)

**19511** CAUSALITY IN THE MODERN FIELD THEORY. D. I. Blokhintsev. At. Energ. (USSR), 14: 105-9(Jan. 1963). (In Russian)

The mathematical form of causality in modern physics is based on 2 concepts: the homogeneous and isotropic Einstein Minkovskiĭ space and the transfer of interaction by physical fields. Application of these concepts to very small distances and time periods leads to erroneous results. It is shown that the currently employed form of the causality principle is derived from macroscopic physics, transforming Green's function to a very small scale; this results in the indeterminancy of many physical values, including elementary particles. Several theoretical approaches are considered, which while retaining the macroscopic causality, alter substantially the causality at the extremely small space-time scale. (TTT)

**19512** LOBACHEVSKIĬ'S KINEMATICS AND GEOMETRY. Ya. A. Smorodinskiĭ. At. Energ. (USSR), 14: 110-21 (Jan. 1963). (In Russian)

Although F. Klein observed in 1909 that the velocity space of the special theory of relativity corresponds to the Lobachevskiĭ space, i.e., to a space with a constant negative curvature, this geometrical model was not used very much for the description of relativistic kinematic phenomena. A number of examples are described from the fields of elementary particles and nuclear reactions in which the Lobachevskiĭ geometry is successfully applied. Attention is attracted to the fact that while operating with vectors in a velocity space, the actual geometry of that space must be clearly understood. Visual presentations and the use of triginometric formulas are not required, but in view of the complexity of the modern theoretical physics, graphic models may be expected to play an important role. The transition from nonrelativistic mechanics to Einstein mechanics is described, reviewing the Tomasov precession and the problems of hyperbolic geometry. Special attention is devoted to the problem of spin, the relation of which to the Lobachevskiĭ geometry was pointed out previously. (TTT)

**19513** NUMERICAL TABLES OF THE RACAH COEFFICIENT CONTAINING FOUR HALF-INTEGERS. T. Dazai. Bull. Tokyo Inst. Technol., Spec. No. 49, 35-52(1962). (In English)

Numerical values of the Racah coefficient containing four half-integers are shown in fractional form for parameters up to 9/2. (auth)

**19514** A DIRECT TERRESTRIAL TEST OF THE SECOND POSTULATE OF SPECIAL RELATIVITY. T. Alvaeger, A. Nilsson, and J. Kjellman (Univ. of Stockholm). Nature, 197: 1191(Mar. 23, 1963).

A preliminary report is presented of a test of the second postulate of special relativity by measuring the velocity difference between $\gamma$ rays from a recoiling nucleus and a nucleus at rest. The moving source was $C(\alpha,\alpha')C^{12*}$ and the rest source was $O^{16}(\alpha,\alpha')O^{16*}$. The 14-Mev $\alpha$ beam and time-of-flight equipment of the Nobel Institute 80-cm cyclo-

tron were used. A systematical deviation in times-of-flight from $\Delta t = 0$, independent of the source-to-detector distance, was present. This systematical error causes the uncertainty of the measurements to be larger than predicted. The result is in agreement with the second postulate, but does not agree with the work of Kantor (J. Optical Soc. Amer., 52: p.978(1962)). (T.R.H.)

**19515** QUANTUM ELECTRODYNAMICS WITH NON-VANISHING PHOTON MASS. G. Meyer-Pundt (Universität, Freiburg i. B.). Z. Physik, 172: 302-13(1963). (In German)

Quantum electrodynamics with non-vanishing photon mass is written in the interaction representation. To apply the Wick decomposition formalism of the S-matrix an indefinite metric $\eta$, similar to that of Gupta-Bleuler's quantum electrodynamics with vanishing photon mass, can be introduced. It is shown that the complementary photons can be eliminated from the formalism with the help of the subsidiary condition. By a succeeding unitary transformation all $\varkappa$-singularities ($\varkappa$ = photon mass) can be removed. The limiting process $\varkappa \to 0$, which then becomes possible, leads to the so-called "reduced" theory of quantum electrodynamics. A physical interpretation of this limiting process is tried using, as a simple example, the radiation of an electric dipole. (auth)

**19516** CONCERNING THE CONCEPT OF PHASE WAVES IN THE THEORY OF GRAVITATION AND ELECTRODYNAMICS. H. Hoenl and J. Ruffer (Universität, Freiburg i. B.). Z. Physik, 173: 5-7(1963). (In German)

Both in Einstein's theory of gravitation and also in special relativistic electrodynamics, moving bodies let themselves be transformed by an advancing phase wave (gravitation waves or electromagnetic waves) under certain conditions to stationary bodies. From a physical standpoint the observation of effects is unsuitable in the coordinate system in which the process is stationary; from the standpoint of the classification of solutions of the general covariant field equation on the other hand the designations "stationary" and "completely stationary" are significant and authorized. (tr-auth)

**19517** STUDIES OF THE RELATION BETWEEN THE SATURATION OF THE INFINITELY EXTENDED NUCLEAR MATTER IN THE THEORY OF BRUECKNER AND THE PARAMETERS OF A TWO-PARTICLE INTERACTION. Malur Ramanna Bhagavan. Thesis, Munich, Universität, 1961. 74p. $2.00; 8 DM.

Using Brueckner's theory for two-particle interaction, a one particle potential for infinitely extended nuclear matter is given. With this potential the energy density is determined from the average potential energy per particle. The minimum of the energy density as a function of matter density corresponds to an optimal matter density for which the nuclear matter is saturated. In this way a correlation between the optimal density and the parameters of the two-body interaction is obtained. The possibility of explaining the differential cross sections for (n,p) and (p,p) reactions by the saturation potentials is discussed. (Gmelin Inst.)

**19518** THEORETICAL PHYSICS. Lectures Presented at the Seminar held at the Palazzino Miramare, Trieste, from 16 July to 25 August, 1962. (International Atomic Energy Agency, Vienna). Jan. 1963. 645p. (STI/PUB/61). $12.00; Sch 252; NF 48; DM 42(IAEA).

Thirty-three papers based on lectures on quantum field theory in axiomatic and Lagrangian formulations, symmetry properties of elementary particles, complex angular momenta and Mandelstam representation, compound systems, and very high energy interactions are included. Separate abstracts were prepared for thirty-one papers. Two papers were previously abstracted in NSA. (D.C.W.)

**19519** RECENT ACHIEVEMENTS OF AXIOMATIC FIELD THEORY. A. Wightman (Princeton Univ., N. J.). p.11-58 of "Theoretical Physics." Vienna, International Atomic Energy Agency, 1963. (In English)

Developments in axiomatic field theory over the last few years are discussed. Areas examined are the PCT theorem, equivalence classes of local fields, generalized free fields, the cluster decomposition problem, scalar field theory axioms and the reconstruction theorem, self adjointness for Hermitian fields, Von Neumann algebras associated with a domain of a field and space-time, Haag-Ruelle collision theory, asymptotic behavior of Klein-Gordon equation solutions, and the refined cluster decomposition theorem. 44 references. (D.C.W.)

**19520** INVARIANT QUANTUM MECHANICAL EQUATIONS OF MOTION. E. P. Wigner (Princeton Univ., N. J.). p.59-82 of "Theoretical Physics." Vienna, International Atomic Energy Agency, 1963. (In English)

As an outgrowth of the extension of the definition domain of intrinsically real variables to complex numbers, some irreducible and unitary representations of the Poincaré group (the inhomogeneous Lorentz group containing displacements in space and time as well as Lorentz transformations) are discussed. Equations of motion for particles with positive rest mass, zero rest mass, and imaginary rest mass are considered. (D.C.W.)

**19521** REDUCTION OF THE ALGEBRA OF FIELD OPERATORS FOR THE CASE OF SEVERAL VACUUM STATES. S. Schleider (Max-Planck-Institut für Physik, Munich). p.83-6 of "Theoretical Physics." Vienna, International Atomic Energy Agency, 1963. (In English)

By using assumptions essentially like those in Wightman's axioms and the resultant property of cluster decomposition, the algebra of field operators is shown to be fully reducible if there are several vacua (states invariant under the inhomogeneous restricted Lorentz-group). The proof is written for a scalar field interacting with itself, but it is still correct for a manifold of fields under certain assumptions. (D.C.W.)

**19522** GAUGE THEORIES OF VECTOR PARTICLES. J. Schwinger (Harvard Univ., Cambridge, Mass.). p.89-134 of "Theoretical Physics." Vienna, International Atomic Energy Agency, 1963. (In English)

The idea of a vector gauge field whose dynamics are governed by the requirement of gauge invariance is examined, and several aspects related to the required new field are discussed. Electrodynamic phenomena are considered, and several gauge theories including relativistic theories are devised and analyzed. (D.C.W.)

**19523** STRONG COUPLING IN A GAUGE INVARIANT FIELD THEORY. K. Johnson (Massachusetts Inst. of Tech., Cambridge). p.135-43 of "Theoretical Physics." Vienna, International Atomic Energy Agency, 1963. (In English)

Some approximations that may be significant in the domain of strong coupling in a field system analogous to quantum electrodynamics are discussed. The idea that the strong couplings and elementary particle spectrum may be the consequence of the dynamics of a system with an underlying description in terms of a set of Fermi fields gauge invariantly coupled to a single massless neutral vector field underlies the work. Dynamics of a single Fermi field gauge invariantly coupled to a neutral vector field are considered. (auth)

**19524** KN AND K̄N INTERACTIONS. R. Capps (Northwestern Univ., Evanston, Ill.). p.147-69 of "Theoretical Physics." Vienna, International Atomic Energy Agency, 1963. (In English)

The strange particles and some of the well-established resonances and interactions are discussed. The parity and spin of the Λ and Σ hyperons are considered, and the P-wave meson-baryon resonances and their significance are examined. Similar treatment is afforded the S-wave meson-baryon interactions. The 1815-Mev resonance is assigned an angular momentum of $^5/_2$. (D.C.W.)

**19525** THE FORMALISM OF LIE GROUPS. A. Salam (Imperial Coll., London). p.173-96 of "Theoretical Physics." Vienna, International Atomic Energy Agency, 1963. (In English)

Theory of compact simple Lie groups is considered. Similarity of these groups with the group of rotations in three dimensions is particularly noted. Aspects examined are casimir operators, canonical forms of the commutation relations and group rank, classification of Lie groups, representations of Lie groups (reducible and irreducible), dimensionality of respresentations, and computation of all weights of a given irreducible representation. (D.C.W.)

**19526** EXPERIMENTAL TESTS OF $SU_3$ AND $G_2$ SYMMETRIES IN STRONG INTERACTIONS. H. Ruegg (Universität, Geneva). p.211-18 of "Theoretical Physics." Vienna, International Atomic Energy Agency, 1963. (In English)

Relations among the scattering amplitudes of baryon-meson and meson-baryon scattering and of baryon-antibaryon annihilation into two mesons are examined. The octet model $SU_3$ and the model of Behrends and Sielen $G_2$ are utilized, and the Pomeranchuk conjecture and theory are discussed as applications. (D.C.W.)

**19527** THE DECOMPOSITION OF DIRECT PRODUCTS OF IRREDUCIBLE REPRESENTATIONS OF SU(3). H. Goldberg (Israel Atomic Energy Commission, Rehovoth). p.219-26 of "Theoretical Physics." Vienna, International Atomic Energy Agency, 1963. (In English)

A technique for decomposing direct products of irreducible representations of the octet model of SU(3) is devised. Extension to other models can be made. (D.C.W.)

**19528** VECTOR MESONS AND UNITARY SYMMETRY. J. J. Sakurai (Univ. of Chicago). p.227-49 of "Theoretical Physics." Vienna, International Atomic Energy Agency, 1963. (In English)

Vector (gauge) theory of strong interactions is discussed, and the hypothesis of the universality of interactions between the vector mesons and the baryon and meson currents is tested. Formulation of the universality principle on the basis of dispersion theory is outlined, and decay modes of the ω meson are analyzed. Unitary symmetry is also treated, particularly D- and F-type unitary symmetric interactions and the mass relation. (D.C.W.)

**19529** OCTONIONS AND SUPER-GLOBAL SYMMETRY. J. Tiomno (Centro Brasileiro de Pesquisas Físicas, Rio de Janeiro). p.251-64 of "Theoretical Physics." Vienna, International Atomic Energy Agency, 1963. (In English)

Properties of the quaternion and octonion algebras are examined, and the octonion algebra is noted to form the $G_2$ group. Nonexistence of other hypercomplex algebra with the neccessary norm property is also considered. (D.C.W.)

**19530** POMERANCHUK CONJECTURE AND SYMMETRY SCHEMES. A. Galindo, A. Morales, and H. Ruegg (Junta de Energia Nuclear, Madrid; European Organization for Nuclear Research, Geneva; and Universität, Geneva). p.265-71 of "Theoretical Physics." Vienna, International Atomic Energy Agency, 1963. (In English)

The implication of Pomeranchuk's conjecture that equalities exist among the total cross sections for charge-exchange processes whenever any symmetry scheme is invoked for the strong interactions is proved for any compact Lie group. The equality of the cross sections is also proved to imply, under certain assumptions, that $S^{-1}$ times the charge-exchange forward scattering absorptive amplitudes tends to zero as S approaches infinity. (D.C.W.)

**19531** DETERMINANTAL METHOD FOR COMPLEX ANGULAR MOMENTA IN POTENTIAL SCATTERING. B. W. Lee (Univ. of Pennsylvania, Philadelphia). p.331-7 of "Theoretical Physics." Vienna, International Atomic Energy Agency, 1963. (In English)

A formulation of the complex angular momenta in potential scattering, based on the Lippman-Schwinger integral equation rather than on the Schrödinger differential equation, is described. Regge trajectories are computed and confirmed by a study of Regge behavior of a perturbation series. (D.C.W.)

**19532** REGGE POLES IN FIELD THEORY. R. Sawyer (Univ. of Wisconsin, Madison). p.339-46 of "Theoretical Physics." Vienna, International Atomic Energy Agency, 1963. (In English)

Properties in the complex angular momentum plane of the Bethe-Salpeter scattering amplitude in the ladder approximation are examined. Developing the solution of the partial wave projection of the amplitude equation as the ratio of two series by the Fredholm method proves a domain of meromorphy in the l-plane. Regge trajectories are derived, and the Regge idea coupled with perturbation theory is proved valuable in summing highly divergent parts of Feynman graph sets. Asymptotes of the trajectories are noted to depend heavily on details of the short range force. (D.C.W.)

**19533** ASYMPTOTIC LIMITS IN POTENTIAL SCATTERING AND IN FIELD THEORY. S. Fubini (Università, Turin). p.347-63 of "Theoretical Physics." Vienna, International Atomic Energy Agency, 1963. (In English)

An approach to high-energy physics based on a model describing high-energy collisions as the result of the combination of a large number of low-energy interactions and allowing an estimate of the main features of elastic diffraction scattering and of multiple production is discussed. Evaluation of the asymptotic limits is not based on the direct study of the linear integral equations of the model. The predictions of the model for elastic diffraction scattering and the relativistic two-body equation are considered. Multiple production predictions are also discussed. (auth)

**19534** ON THE EQUATION FOR THE REGGE TRAJECTORIES. R. Stroffolini (Università, Naples). p.365-77 of "Theoretical Physics." Vienna, International Atomic Energy Agency, 1963. (In English)

General methods for studying the Regge trajectories in relativistic and nonrelativistic potential theory are discussed. Formulation of the trajectory equation by transforming the usual Schrödinger equation to a more suitable form for analytic continuation in the angular momentum variable is demonstrated. Weak coupling approximations are obtained for relativistic two-body situations and for nonrelativistic cases. Asymptotic limits for these equations are examined. (D.C.W.)

**19535** HIGH-ENERGY PROPERTIES OF THE MANDELSTAM REPRESENTATION. M. Froissart (Centre

d'Études Nucléaires, Saclay, France). p.379-99 of "Theoretical Physics." Vienna, International Atomic Energy Agency, 1963. (In English)

Development of the concept of Regge poles is discussed. Mandelstam representation and its failings are presented, and introduction of Regge poles to explain asymptotic behavior noted in potential scattering is described. Bardacki's work on proving the existence of Regge poles in relativistic S-matrix theory is reviewed. Chew's hypothesis and its explanation of previously observed paradoxes are included. Accumulation of Regge poles around certain points is considered as are approaches to testing the Regge pole concept. (D.C.W.)

**19536** REGGE POLES AND STRIP APPROXIMATION. S. Mandelstam (Univ. of Birmingham, Eng.). p.401-20 of "Theoretical Physics." Vienna, International Atomic Energy Agency, 1963. (In English)

Construction of the double spectral function from unitarity is demonstrated, and an iteration procedure for calculating the potentials associated with the revised double-dispersion representation is outlined. Calculation of the scattering amplitude from the spectral functions when there are subtractions in the momentum transfer dispersion relation is also discussed, and the conjecture that the exact scattering amplitude has a Regge asymptotic behavior is examined. (D.C.W.)

**19537** THE ONE-PION EXCHANGE MODEL AND ITS RELATION TO REGGE POLE EXCHANGE. S. Frautschi (Cornell Univ., Ithaca, N. Y.). p.421-8 of "Theoretical Physics." Vienna, International Atomic Energy Agency, 1963. (In English)

Features of the one-pion exchange model are described, and its limitations are pointed out. Treatment of scattering in terms of Regge pole exchange is discussed, and advantages of describing large momentum transfer events in such terms are presented. (D.C.W.)

**19538** REGGE POLES AND DRELL'S PRODUCTION OF HIGH-ENERGY PARTICLES. A. P. Contogouris (Democritos Nuclear Research Center, Athens). p.429-34 of "Theoretical Physics." Vienna, International Atomic Energy Agency, 1963. (In English)

Drell's proposed mechanism for the production of high-energy particles by photons is re-evaluated under the assumption that Regge poles rather than an elementary particle are exchanged. The magnitude of the coupling constant in the photoproduction of pions on nucleons is also examined. (D.C.W.)

**19539** UNITARITY AND PRODUCTION AMPLITUDES (APPLICATION TO $\pi$N HIGHER RESONANCES). B. W. Lee (Univ. of Pennsylvania, Philadelphia). p.437-47 of "Theoretical Physics." Vienna, International Atomic Energy Agency, 1963. (In English)

A model of higher resonances in $\pi$-N scattering, based on the analyticity and unitarity of the production and three-particle-to-three-particle scattering amplitudes, is discussed. In this model, a strong coupling between the $\rho$-N and $\pi$-N channels accounts for the resonances. (D.C.W.)

**19540** COMPOUND PARTICLE MODELS. W. Thirring (Universität, Vienna). p.451-81 of "Theoretical Physics." Vienna, International Atomic Energy Agency, 1963. (In English)

Bound states and resonances in quantum field theory are examined using the Zachariasen model. The summation of chain diagrams to obtain the scattering amplitude is performed, and the poles of the amplitude are considered to get information on the bound states and resonances. Bound state coupling constants are derived and analyzed, and the analytic properties of the scattering amplitude are explored. The propagator of the model is calculated, and its spectral representation is obtained. Form-factors are also examined. More realistic models are considered, and the scattering amplitude incorporating crossing symmetry is derived. Appearance of the resonances in the form factors for cases with and without anomalous thresholds is treated. (D.C.W.)

**19541** VERY HIGH-ENERGY PHENOMENA. S. Hayakawa (Nagoya Univ., Japan). p.485-520 of "Theoretical Physics." Vienna, International Atomic Energy Agency, 1963. (In English)

Techniques for classifying secondary particles from interactions involving high-energy cosmic rays are discussed along with methods for determining the energy of the incident particle. Techniques for evaluating energies of neutral photons and pions are also presented. Transverse momentum, momentum transfer, and elasticity and multiplicity are other interaction properties considered. Use of wave, particle or quantum descriptions to study certain aspects of interactions is explored. Several fireball models are also examined. 25 references. (D.C.W.)

**19542** A MODEL FOR HIGH-ENERGY NUCLEON-NUCLEUS COLLISIONS. J. Werle (Inst. of Nuclear Research, Polish Academy of Sciences, Warsaw). p.521-7 of "Theoretical Physics." Vienna, International Atomic Energy Agency, 1963. (In English)

Failure of a simple statistical model to account for several aspects on non-relativistic particle emission in high-energy nucleon-nucleus collisions is discussed. A model based on fragmentation of the recoil nucleus due to the action of long range forces is suggested. (D.C.W.)

**19543** STRONG DAMPING OF LARGE MOMENTUM TRANSFERS, AND ITS CONSEQUENCES FOR HIGH-ENERGY INELASTIC PROCESSES. S. Frautschi (Cornell Univ., Ithaca, N. Y.). p.529-39 of "Theoretical Physics." Vienna, International Atomic Energy Agency, 1963. (In English)

Inelastic scattering at very high energies is investigated under the assumption that the exponential damping of large momentum transfers is a general characteristic of high-energy amplitudes. The damping rate is taken from existing p-p results and extended to inelastic p-p and $\pi$-p events. The breakdown into low-energy particle clumps previously used with the one-pion exchange model is followed, but with no restriction to one-pion exchange between clumps. Constant transverse momentum of secondary particles and fireballs appears with reasonable magnitudes. Momentum transfers are emphasized to be comparably small at machine energies and at higher energies. A definite conception of the fireball is derived, and development of a Regge pole formalism for highly inelastic events is discussed. (D.C.W.)

**19544** METHODS FOR ACCURATE CALCULATIONS IN HIGH-ENERGY QUANTUM ELECTRODYNAMICS. K. E. Ericsson (Uppsala Univ.). p.543-54 of "Theoretical Physics." Vienna, International Atomic Energy Agency, 1963. (In English)

Methods for summing part of the perturbation expansion of renormalized quantum electrodynamics are examined. The mechanism of low-energy radiation is investigated. Then summation over the Feynmann infrared divergent diagrams is treated. The renormalizability of quantum electrodynamics is used in a summation of a certain class of terms that dominate at high momentum transfers. A

combination of the two summations is also considered. (D.C.W.)

**19545** SOFT-PHOTON CONTRIBUTION TO ELECTRODYNAMICAL CROSS-SECTIONS AT VERY HIGH ENERGIES. G. Furlan (Università, Trieste, Italy). p.555-61 of "Theoretical Physics." Vienna, International Atomic Energy Agency, 1963. (In English)

The soft photon contribution to radiative corrections at very high energies is examined. The cross section for electron-positron annihilation into photons up to $\alpha^3$ order is treated, and generalization to every order of $\alpha$ is explored. (D.C.W.)

**19546** INFRARED DIVERGENCE PHENOMENA, HIGH-ENERGY PROCESSES, AND REGGE POLES. S. Frautschi (Cornell Univ., Ithaca, N. Y.). p.563-8 of "Theoretical Physics." Vienna, International Atomic Energy Agency, 1963. (In English)

Semiclassical arguments for infrared divergence for real photons, angular distribution of radiation from potential-deflected charges, and the cancellation between real and virtual infrared divergences are reviewed, and derivation of these phenomena from quantum electrodynamics is described. Infrared terms are noted to provide most of the radiative correction at high energies, and the necessity for treating long range effects is illustrated. Regge-like behavior in the infrared correction terms is also discussed. (D.C.W.)

**19547** EXPERIMENTS WITH ELECTRON COLLIDING BEAMS. R. Gatto (Comitato Nazionale per le Ricerche Nucleari, Frascati, Italy). p.569-90 of "Theoretical Physics." Vienna, International Atomic Energy Agency, 1963. (In English)

The storage ring to be used in experiments with $e^+ - e^-$ colliding beams is described, and perturbation theory calculations of the cross sections for several annihilation events are given. Studies to be made with such beams are discussed, and ideas for theoretical analysis of the reactions are reviewed. Cross sections for processes going through intermediate $\rho^0$ and $\omega^0$ that can give resonant contributions are examined. Cross sections, branching ratios, and angular correlations for $p-\bar{p}$ annihilation processes to be checked experimentally are also discussed. (D.C.W.)

**19548** WEAK INTERACTIONS AT HIGH ENERGIES. A. Pais (Inst. for Advanced Study, Princeton, N. J.). p.593-618 of "Theoretical Physics." Vienna, International Atomic Energy Agency, 1963. (In English)

Some unresolved questions in the theory of weak interactions are examined. Pure leptonic processes such as $\mu$-decay and lepton-lepton scattering are explored, and difficulties in the high frequency behavior of the Fermi-interactions treated in lowest order are discussed. General aspects of weak radiative effects are also considered, particularly the magnitude of the higher order corrections. Reactions that cannot occur in lowest order, but are not forbidden are considered along with speculations about invariance groups for lepton problems that may be relevant to higher order weak effects. The general structure of the heavy particle currents as they enter in the weak interactions with particular reference to CP-invariance and to a $|\Delta\vec{T}| = 1$ rule for the strangeness conserving processes are reviewed. The principles of local actions of lepton currents that may be of interest for experimental exploration of weak radiative corrections are also discussed. 59 references. (auth)

**19549** THE INTERACTIONS IN $K_{\mu 3}$ AND $K_{e3}$ DECAY. S. W. McDowell (Centro Brasileiro de Pesquisas Físicas, Rio de Janeiro). p.619-29 of "Theoretical Physics." Vienna, International Atomic Energy Agency, 1963. (In English)

Some properties of the transition amplitudes, independent of the structure of form factors, are examined for K meson leptonic decay. These provide a test of universality and a criterion for unambiguous determination of the nature of the weak interaction in these processes. Structure of the form factors is discussed by means of dispersion relations and introducing explicitly the effect of the $K^*$-resonance in the K-$\pi$ interaction. (auth)

# REACTOR TECHNOLOGY

## General and Miscellaneous

*Refer also to abstracts 18702 and 19556.*

**19550** (AECL-1705) BIBLIOGRAPHY ON REACTOR SAFETY. G. C. Garrow, comp. (Atomic Energy of Canada Ltd., Chalk River, Ont.). Feb. 1963. 83p.

Abstracts of 162 selected articles on the general subject of reactor safety for the period Jan. 1960 to Sept. 1962 are presented. The abstracts are separated into subject groups, but are not listed in alphabetical order by report number. (H.G.G.)

**19551** (ANL-6690) CRITICAL STUDIES OF URANIUM–STEEL AND URANIUM–STEEL–SODIUM FAST REACTOR CORES. (ZPR-III ASSEMBLIES 32 and 33). P. I. Amundson, W. Gemmell, J. K. Long, and R. L. McVean (Argonne National Lab., Idaho Falls, Idaho). Feb. 1963. Contract W-31-109-eng-38. 26p.

Critical studies of two fast reactor cores are described: one contains uranium and steel; the other contains uranium, steel, and sodium. Experimental results are given for fission ratio, central and edge reactivity coefficients, fuel bunching, average prompt neutron lifetime, and distributed worth measurements. (auth)

**19552** (APAE-Memo-140) THE PRELIMINARY SHIELD DESIGN FOR THE 50 MW COMMERCIAL REACTOR. R. O. Bagley, Jr. (Alco Products, Inc., Schenectady, N. Y.). Dec. 18, 1958. 194p.

Preliminary calculations are presented concerning required reactor shielding, heating in core components, thermal stresses, and temperature distributions in structural and load bearing members. A previously neglected aspect was brought to light concerning the intensity of the capture gamma flux from the concrete shield. Results of calculations on flux peaking in water gaps, induced activity in the pressure vessel head, and above-core water height are included. Data and other information on gamma heat removal and determination of source strength are also included. (J.R.D.)

**19553** (APDA-150) METHODS FOR DETERMINING THE ENERGY RELEASE IN HYPOTHETICAL REACTOR MELTDOWN ACCIDENTS (thesis). Richard B. Nicholson (Atomic Power Development Associates, Inc., Detroit). Dec. 1962. 185p.

A method for estimating the energy release in hypothetical fast reactor meltdown accidents, based on the hypotheses that the melted core of a reactor is rearranged in such a way that it forms a secondary critical assembly and that there is a constant rate of reactivity increase is evaluated. The mechanism for terminating the resulting power excursion is assumed to be disassembly of the core due to the pressure of vaporized uranium produced by the excursion. The Bethe-Tait method for calculating energy release is discussed and modified to include polynomial approximations to the power distribution and reactivity worth distribution, as well as a different treatment of the movement of material near the core surface. The energy release is shown to be approximately the same for tamped and untamped cores for rates of reactivity increase up to 6.4 $sec^{-1}$, the highest rate treated. An improved method that eliminates some of the approximations of the Bethe-Tait method and is programmed for the IBM-7090 digital computer is presented. It is shown that the threshold equation of state generally used in previous energy release calculations tends to cause an overestimate for weak and moderate excursions, and that the saturated vapor pressure must be considered in these cases. The influence of the delayed neutrons is evaluated and shown to be small. The dependence of the energy release upon prompt neutron generation time, initial power level, rate of reactivity insertion, and Doppler effect is investigated. It is shown that in some cases Doppler effect can limit the energy release to a small value even for high rates of reactivity insertion. A method for calculating the material movement and reactivity reduction in two dimensional cylindrical geometry is presented and applied to a calculation of the energy release for two particular configurations. A simple spherical model is developed which gives good agreement with the two-dimensional calculations. 61 references. (auth)

**19554** (BNL-774) A REVIEW OF NONLINEAR REACTOR DYNAMICS PROBLEMS. Jack Chernick (Brookhaven National Lab., Upton, N. Y.). July 1962. Contract [AT(30-2)-Gen-16]. 10p. (BNL-T-291)

Some of the major physical problems that have arisen in reactor dynamics are summarized. Discussions of the more simple reactor dynamics models and the methods developed to solve them are included along with an examination of the limitations of model solutions. (J.R.D.)

**19555** (CRCE-1142) EQUIPMENT FOR STUDYING FOULING IN ORGANIC COOLANT SYSTEMS. A. R. Bancroft (Atomic Energy of Canada Ltd., Chalk River, Ont.). Mar. 1963. 18p. (AECL-1706)

A small-scale circulating system for screening the variables influencing fouling in organic coolants for nuclear reactors was built and tested for several months at bulk temperatures of 375°C, system pressures of 21 kg/$cm^2$, and flows of 40 to 60 g/sec. The system requires 200 g of coolant to fill the flow circuit and can be cooled down, discharged, recharged, and reheated to operating temperature in about four hours. A fouling probe developed for use in the small loop was also used in out-reactor fouling loop and the fuel test loop in the NRX reactor. Experience indicates that fouling mechanisms observed on large heated surfaces can be duplicated both as to deposition rate and film composition on the fouling probe. It can therefore be used as a tool for monitoring coolant fouling potential in large systems. (auth)

**19556** (DP-806) MINIATURE PURIFICATION PROGRESS REPORT. II. TESTS III THROUGH VI. Elizabeth W. Baumann (Du Pont de Nemours (E. I.) & Co. Savannah River Lab.). Dec. 1962. Contract AT(07-2)-1. 55p.

Small columns of ion exchange resin were used in an out-of-pile loop for experimental study of the purification of $D_2O$ from a Savannah River production reactor. Evolution of the exhaustion profiles of resins, the removal of radionuclides, the relative efficiencies of cation exchange resin and mixed-resin columns, and the performance of a weak-base resin were investigated. The average ionic composition of the reactor $D_2O$ was determined. (auth)

**19557** (GEAP-4161) PROGRAM FOR THE DEVELOPMENT OF PLUTONIUM RECYCLE FOR USE IN LIGHT WATER MODERATED REACTORS. Seventh Quarterly Report, October 1–December 31, 1962. M. A. Robkin (General Electric Co. Vallecitos Atomic Lab., San Jose, Calif.). Dec. 31, 1962. Work performed under United

States–Euratom Joint Research and Development Program. Contract AT(04-3)-189. 21p. (EURAEC-576)

Activities in a program to determine data for use in predicting the long-term changes in isotopic composition and reactivity of Pu-enriched, light-water-moderated reactors are reported. The required data are being obtained from a high-burnup experiment using a U–Pu lattice typical of light-water-moderated reactors. The VBWR, in which the experiment is being conducted, was shut down during the report period. The fuel exposure at shutdown was estimated to be 2430 Mwd/t. Other work during the quarter included sampling of the rod which was removed at 2000 Mwd/t and replanning experiments on flux wires. (J.R.D.)

**19558** (HW-75007) PLUTONIUM AS A POWER REACTOR FUEL. Proceedings of American Nuclear Society Topical Meeting, Richland, Washington, September 13 and 14, 1962. F. G. Dawson, comp. (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Dec. 1962. Contract [AT(45-1)-1350]. 530p.

A total of twenty-eight papers was presented at the meeting. Nine of these papers were previously abstracted in NSA. Separate abstracts were prepared for nineteen papers. (J.R.D.)

**19559** (HW-75007(Paper 1)) PLUTONIUM AS A POWER REACTOR FUEL. U. M. Staebler (Atomic Energy Commission, Washington, D. C.). 6p.

A brief review of the bases for interest in Pu as a reactor fuel is presented. Discussions are presented on the role of Pu in nuclear power, A.E.C. interests, and Pu technology development status. (J.R.D.)

**19560** (HW-75007(Paper 3)) THE PLUTONIUM-BASED FUEL PRODUCTION PROGRAMMES IN FRANCE. P. Bussy (France. Commissariat à l'Énergie Atomique. Centre d'Études Nucléaires, Cadarache). 24p.

A description of the Cadarache research center is presented. This facility was designed to study the manufacture of Pu fuel prototypes. The present program at the facility includes fabrication of fuel for RAPSODIE and production of Pu–U alloy slugs for the critical experiments AQUILON and MARIUS. Information is included concerning use of Pu in thermal and fast reactors. (J.R.D.)

**19561** (HW-75007(Paper 4)) RESEARCH ON THE FABRICATION, PROPERTIES AND IRRADIATION BEHAVIOUR OF PLUTONIUM FUELS FOR THE U. K. REACTOR PROGRAMME. B. R. T. Frost, P. G. Mardon, and L. E. Russell (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England).

It is noted that the U. K. nuclear power program is presently based on gas-cooled reactors designed to provide an output of nearly 5,000 Mw by 1968. Such an integrated nuclear power system requires development of various types of reactors and maintenance of a suitable balance between them and general development of Pu-bearing fuels. Developmental work on U–Mo–Pu fuels is reported along with work on oxides, carbides, and cermets containing Pu. (J.R.D.)

**19562** (HW-75007(Paper 9)) PLUTONIUM FUEL DEVELOPMENT PROGRAMS AT NUCLEAR MATERIALS AND EQUIPMENT CORPORATION. Karl H. Puechl (Nuclear Materials and Equipment Corp., Apollo, Penna.). 19p.

Discussions are presented concerning NUMEC capabilities for Pu fuel development. Current programs at NUMEC are also discussed, and recent analytical and experimental data are presented. (J.R.D.)

**19563** (HW-75007(Paper D1)) BATTELLE'S COMPOUND AND PLUTONIUM ALLOY DEVELOPMENT PROGRAMS. W. M. Pardue and V. W. Sorhok (Battelle Memorial Inst., Columbus, Ohio). 3p.

Efforts at Battelle devoted to development of $PuO_2$ technology are discussed. Information is included on alloy and compound development. (J.R.D.)

**19564** (HW-75007(Paper D2)) PLUTONIUM REACTOR FUELS RESEARCH PROGRAM AT MOUND LABORATORY. Lerroy V. Jones and Layton J. Wittenberg (Mound Lab., Miamisburg, Ohio). 12p.

Efforts at this facility are directed toward obtaining fundamental information concerning Pu-bearing potential reactor fuels. Fuel materials for high-temperature fast breeder reactors are emphasized. Research work being done on Pu phase studies, measurement of physical and thermal properties associated with Pu systems, and preparation and characterization of Pu-bearing ceramic systems is discussed. (J.R.D.)

**19565** (HW-75007(Paper D3)) PLUTONIUM FUEL PROGRAMS OF THE UNITED NUCLEAR CORPORATION. A. A. Strasser (United Nuclear Corp. Development Div., White Plains, N. Y.). 5p.

A developmental program devoted to U–Pu carbides for use as fast reactor fuels is described. Production of carbide powder by reaction of $PuO_2$–$UO_2$ mixtures with C is described, and plans for their irradiation are discussed. A discussion is also included concerning design of the facilities for carbide development. (J.R.D.)

**19566** (HW-75007(Paper 11)) EXPERIENCE WITH THE PLUTONIUM RECYCLE TEST REACTOR. R. I. Smith and R. E. Peterson (General Electric Co. Hanford Atomic Products Operation, Richland). 10p.

The Plutonium Recycle Test Reactor (PRTR) is an experimental facility designed to support the development of Pu fuel cycles in thermal power reactors. The reactor design is aimed at providing a versatile test facility with prototype power reactor operating conditions in which it is possible to demonstrate the feasibility of recycling Pu fuels. Information concerning experience with PRTR is presented in sections on fuel, loading, and reactor kinetics. Conclusions based on the first year's operation are included. (J.R.D.)

**19567** (HW-75007(Paper D4)) PLUTONIUM IN THE SWEDISH POWER REACTOR PROGRAM. Lars Zettergren (Aktiebolaget Atomenergi, Stockholm). 9p.

It is noted that the Swedish reactor development program is relatively slow and is devoted largely to heavy water systems. Sweden has great reserves of low-grade U ore but no known Th. No U isotope separation plant is available or planned for Sweden. A review of the state of research in Sweden is presented along with discussions of fuels and fuel cycles, the economic potential of Pu, and technical problems associated with Pu fuel development. (J.R.D.)

**19568** (HW-75007(Paper D5)) THE EURATOM-AEC PLUTONIUM RECYCLE PROGRAM AT VALLECITOS ATOMIC LABORATORY. J. G. Carver (General Electric Co. Vallecitos Atomic Lab., San Jose, Calif. and General Electric Co. Vallecitos Atomic Lab., Pleasanton, Calif.). 4p.

It is noted that long-term Pu-bearing fuel irradiations, accompanied by thorough assays of the material, are necessary to confirm models designed to describe the detailed course of fuel burnup. Progress at Vallecitos includes burnup of Pu-enriched fuel at about 2000 Mwd/t in the centers of the elements. A sample was removed from a burnup-test element and measurements are planned. (J.R.D.)

**19569** (HW-75007(Paper 14)) THE PHYSICS OF PLUTONIUM IN FAST REACTORS. D. Okrent (Argonne National Lab., Ill.) and F. W. Thalgott (Argonne National Lab., Idaho Falls, Idaho). 33p.

A review of the Pu behavior physics associated with medium and large fast reactors is presented. The relative reactivity worth and breeding potential of the various Pu isotopes are deduced from examination of pertinent cross sections. This information is used as a basis for examination of a broad range of fast reactors. Other discussion is concerned with Doppler effect, Na reactivity coefficient, selected kinetics, and reactor safety. (J.R.D.)

**19570** (HW-75007(Paper 15)) PLUTONIUM AS A FUEL FOR THE FAST REACTOR RAPSODIE. F. Sebilleau and C. P. Zaleski (France. Commissariat à l'Énergie Atomique. Centre d'Études Nucléaires, Fontenay-aux-Roses). 17p.

Aspects of the proposed use of Pu in fast reactor systems are discussed. Possible fuels for RAPSODIE are examined along with parameters which characterize their neutronic and thermal properties. (J.R.D.)

**19571** (HW-75007(Paper 16)) PLUTONIUM AS A FUEL FOR THE EXPERIMENTAL BREEDER REACTOR II (EBR-II). L. J. Koch (Argonne National Lab., Ill.). 23p.

Construction of EBR-II is nearing completion. A primary objective of this reactor is to demonstrate the feasibility of fast reactor operation with an integrated fuel cycle operating on short-time cooled small-inventory fuels. Discussion of the EBR-II fuel cycle is illustrated, and data concerning fuel alloys are given. (J.R.D.)

**19572** (HW-75007(Paper 17)) PLUTONIUM AS A FUEL FOR THE FAST CERAMIC REACTOR. F. J. Leitz (General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.). 16p.

Results of design, testing, and evaluation of mixed Pu–U oxide fuel for large Na-cooled fast reactors are discussed. Information gained indicates that such reactors can be designed to offer stable and safe reactor dynamics characteristics and low fuel cycle costs. (J.R.D.)

**19573** (HW-75007(Paper 18)) FUEL ELEMENTS FOR FAST REACTORS. P. Brock, L. H. Cope, and K. Q. Bagley (United Kingdom Atomic Energy Authority. Reactor Group, Dounreay, Caithness, Scotland). 12p.

Fuel elements for use in the U. K. fast reactor program are discussed. Materials considered are Pu-bearing cermets, oxides, carbides, and alloys. Technical problems associated with fabrication are discussed. It is concluded that the carbides and alloys appear to have a higher potential for use than the other materials. (J.R.D.)

**19574** (HW-75007(Paper 21)) AN ASSESSMENT OF PLUTONIUM USE. W. Bennett Lewis and O. J. C. Runnalls (Atomic Energy of Canada Ltd., Chalk River, Ont.). 15p.

An economic assessment of Pu use is presented which includes a review of uses for separated fissile materials such as those involved in fuel enrichment for thermal reactors, applications in long-lived reactors, and in fast neutron breeder reactors. The fuel cost comparison involves the relative costs of natural U and those of processing and fabricating enriched fuel. (J.R.D.)

**19575** (HW-75007(Paper 22)) DESCRIPTION OF THE BELGONUCLEAIRE–C.E.N. PLUTONIUM PROJECT. E. Vanden Bemden (Société Belge pour l'Industrie Nucléaire, Brussels). 36p.

Information is presented concerning project history, organization, and facilities. Details of program studies are given on mixed Pu and U oxides, mixed carbides, and dispersions of Pu oxides and carbides in metals. It is noted that fabrication methods were developed for the most usual Pu fuels. Plans for Pu irradiation testing are discussed. (J.R.D.)

**19576** (HW-75007(Paper 23)) PLUTONIUM RECYCLE VALUES IN THERMAL AND FAST REACTORS AND EXPECTED PATTERNS OF USE OF PLUTONIUM. E. L. Zebroski, B. Wolfe, P. Greebler, and J. Sueoka (General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.). 49p.

Discussions are presented concerning the use of Pu in thermal reactors to reduce the amount of $U^{235}$ makeup required to attain any specified fuel lifetime or to increase the reactivity lifetime available for a specified control strength. Discussions are also included concerning method of calculation of Pu value for thermal recycle, fueling patterns for use with thermal reactor recycle, specialized reactor cycles, results of recycle calculations, reactivity lifetime and control range effects of Pu recycle, fabrication costs for Pu-bearing fuels, and Pu value estimates. Other information is included concerning Pu use in fast reactors and supply and value relations including estimated rate of Pu accumulation from power reactor operation, expected patterns of Pu use, and aspects of Pu buyback. (J.R.D.)

**19577** (HW-75007(Paper D6)) U. K. STUDIES RELATING TO PLUTONIUM BURNING IN THERMAL REACTORS. D. Hicks (United Kingdom Atomic Energy Authority. Reactor Group. Atomic Energy Establishment, Winfrith, Dorset, England). 3p.

A review of theoretical and experimental studies in the U. K. on the reactor physics of Pu burning in thermal reactors is presented. Preliminary survey studies are being followed up by detailed calculations related to specific reactor designs. (J.R.D.)

**19578** (HW-76182) PRTR FUEL ELEMENT EXTRACTOR. M. E. Shockley (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Jan. 15, 1963. Contract AT(45-1)-1350. 15p.

A description of the design and operation of an extractor for stuck PRTR fuel tubes is presented. The extractor was designed for operation in the storage basin. It was tested under simulated stuck fuel element conditions, and was found to perform satisfactorily for pushing a stuck 19-rod fuel element. The test shows that the additional binding of the fuel element in the process tube caused by high (1900 lb.) compressive loads is negligible, and that only 515 lbs of force were required to push a fuel element when a broken bundle wire wrap was lodged between the fuel element and the process tube. (J.R.D.)

**19579** (IDO-16428(Rev.1)) IN-TANK IRRADIATION FACILITIES IN THE MTR AND ETR (STANDARD PRACTICES GUIDE). A. S. Richardson, ed. (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). Mar. 15, 1963. Contract AT(10-1)-205. 70p.

A guide was prepared as an aid to the experimenter in his planning and designing of capsule-type irradiations in the MTR and ETR. A complete description of the facilities available for capsule-type irradiations is presented. Standard capsules and capsule holders or baskets are also described. A generalized discussion of typical designs of various types of capsules is included. In addition, the requirements for irradiation of capsule-type experiments are presented. (auth)

**19580** (IDO-16829) SPERT PROJECT QUARTERLY PROGRESS REPORT, JULY–SEPTEMBER 1962.

F. Schroeder, ed. (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). Feb. 28, 1963. Contract AT(10-1)-205. 42p.

In the Spert I facility final preparations were made for destructive testing of a highly enriched, plate-type, water-moderated core. Several non-destructive excursion tests were performed to evaluate the performance of instrumentation to be used for the destructive test. Additional void coefficient measurements were performed to determine the effect of nonuniform void distributions on the void worth in the central region of the core. Analysis of data from the 4.6-msec-period excursion test performed last quarter was completed. In this test about 20% of the fuel plates in the core experienced melting over some portion of their length, but only about 3% of the total fuel plate surface area actually showed melting. Investigations of the effect of initial system temperature on the kinetic response of the $D_2O$-moderated, expanded-configuration core in Spert II were completed. The test series included self-limiting power excursions with initial periods in the range from 5 sec to 40 msec at initial system temperatures of 20, 40, 60, 80, and 100°C. The tests all were initiated by step-wise insertions of reactivity, and were conducted with no forced coolant flow and with the system pressure near atmospheric. The results of this series confirmed expectations that increasing initial system temperature causes a decrease in the peak power, burst energy, and fuel plate surface temperatures attained for a test with a given initial period. The increased dependence on steam formation for shutdown as subcooling is decreased leads to secondary power oscillations larger than those observed at ambient temperature. The presence of an expansion space in the reactor vessel was found to decrease the amplitude of the secondary power oscillations, increase the oscillation frequency, and decrease the magnitude of transient pressures produced. Operation of the Spert IV facility was begun in this quarter. An operational core loading comprised of 25 Spert type D fuel assemblies in a 5 × 5 array was found to have an excess reactivity of about 5.4 dollars. Measurements are being made of rod worths, flux distributions, and reactivity coefficients in preparation for performance of experimental studies of the stability of this core under various system conditions. A new computer program was written to improve the accuracy of calculations of reactivity based on observed power behavior during excursion tests. Metallurgical examinations were made of samples from two fuel plates from the core used in the 5-msec-period power excursion conducted last quarter in Spert I. Estimates were made of the temperatures reached by the plates, based on interpretation of photomicrographs. Investigation of corrosion observed on Al-clad fuel plates which were being stored under water indicated that the plates have an activated surface, probably caused by the stripping operation performed during fabrication of the plates. (auth)

**19581** (JPL-TR-32-385) A NUCLEAR REACTOR CONCEPT FOR ELECTRIC PROPULSION APPLICATION. Jerry P. Davis (California Inst. of Tech., Pasadena. Jet Propulsion Lab.). Mar. 4, 1963. Contract NAS 7-100. 35p. (N63-14413)

The generally desired startup and operational features of a turboplant nuclear reactor system for electric propulsion application are discussed and typical requirements enumerated. A reactor conceptual design in the 10-Mw heat range employing a nonsolid fuel element was chosen in order to circumvent U burnup-radiation damage limitations on core loading for lifetimes substantially in excess of 10,000 full-power hours. The primary and secondary loop flow cycles, nuclear characteristics, startup, and operational control concepts are briefly discussed. Experimental programs now underway and planned for the future at the Jet Propulsion Laboratory in support of the outlined design studies are also presented. (auth)

**19582** (JÜL-89-RE) EINFÜHRUNG IN DIE TECHNOLOGIE DER KERNBRENNSTOFFE FÜR REAKTOR-BETRIEBSINGENIEURE. (Introduction to the Technology of Nuclear Fuels for Reactor Engineering). Walter Toepfer (Kernforschungsanlage, Jülich, Germany). Dec. 1962. 59p.

The occurrence, history, and properties of uranium are reviewed. Preparation of uranium concentrates, preparation of high-purity compounds, reduction to metal, and enrichment of $U^{235}$ are described. The metallurgy of nuclear fuels including uranium, uranium alloys, $UO_2$ UC, cermets, and liquid fuels is discussed. The preparation of various types of fuel elements is also discussed. (M.C.G.)

**19583** (KAPL-M-SR-2) TER4—REACTOR TRANSIENT ANALYSIS PROGRAM. S. A. Ryan (Knolls Atomic Power Lab., Schenectady, N. Y.). Jan. 1963. Contract W-31-109-eng-52. 73p.

TER4 is an open loop reactor transient program which determines reactor power and temperature transients resulting from the insertion or removal of reactivity. By open loop is meant that feedback from the secondary system is neglected. Reactivity may be inserted or removed by control rod motion and/or changes in reactor coolant temperature combined with the temperature coefficient effect. The space independent, one energy group, reactor kinetics equations with six delayed neutron groups are solved using Euler's method. For the thermal calculations, a one dimensional heat transfer model of a one pass reactor is employed. The number of nodes in both the axial and radial directions is variable. Only the nominal channel is considered. Program output includes reactor power level, total reactivity, reactor period, reactor rate, nominal channel temperatures (coolant, clad, and fuel), and integrated reactor power. (auth)

**19584** (NAA-SR-Memo-7343) ORGANIC REACTOR HEAT TRANSFER MANUAL. (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Dec. 1, 1962. Contract AT(11-1)-Gen-8. 92p.

A collection of data, methods, and relations currently considered most reliable for the thermal design and analysis of organic-cooled reactors is presented as a manual. The information is presented in sections on generalized design relations, heat conduction, coolant physical properties, convective and boiling heat transfer, critical heat flux, core hydraulics, and hot-channel factors. Emphasis is placed on presenting information specifically applicable to organic-cooled systems and not generally available in standard reference tests. (auth)

**19585** (STL-6112) KINETIC STUDIES OF HETEROGENEOUS WATER REACTORS. Annual Summary Report, 1961. W. W. Brown, A. L. Morse, R. W. Wright, G. C. K. Yeh, and S. M. Zivi (Space Technology Labs., Inc., Redondo Beach, Calif.). Dec. 30, 1961. Contract AT(04-3)-372. 114p.

Activities in a project to provide data and interpretations which may be useful in predicting the severity and likelihood of power excursions in heterogeneous water reactors are reported. The work may be categorized as studies of large initial transients which result when large amounts of

reactivity are suddenly added to reactors, and studies of conditions which give rise to divergent power oscillations such as those observed in the SPERT IA reactor. The work is reported in sections on shutdown mechanisms in heterogeneous water reactors, analysis of pressure transients, and studies related to boiling water reactor stability. Other information is included on uniform expansion of a spherical piston in an ideal compressible fluid and exponential expansion of a spherical piston in an ideal incompressible fluid. (J.R.D.)

**19586** (UNC-5051) PAWLING LATTICE TEST RIG—TEST REPORT NO. 6. THE EFFECT OF HYDROGENEOUS COOLANTS ON $D_2O$ MODERATED LATTICES. W. L. Brooks, M. R. Fleishman, G. G. Foster, C. W. Monroe, R. D. Schamberger, H. Soodak, and R. Sullivan (United Nuclear Corp. Development Div., White Plains, N. Y.). Mar. 21, 1963. Contract AT(30-1)-3023. 48p.

A series of $k_\infty$ and void coefficient measurements in the PLATR to investigate the effects of hydrogeneous coolants on the $k_\infty$ value of $D_2O$-moderated $UO_2^-$ and UC-fueled lattices is described. The ROCKLAND-A code was revised to provide calculated results for the experiments. A computational technique for tubular fuel elements was also established. The program was conducted as part of an evaluation of the future potential of natural U, $D_2O$-moderated reactors. (J.R.D.)

**19587** (WAPD-TM-300) STRESS ANALYSIS WITH APPLICATIONS TO PRESSURIZED WATER REACTORS. P. L. Pfennigwerth (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). Jan. 1963. Contract AT(11-1)-Gen-14. 402p.

Notes based on portions of lectures given in the course "Stress Analysis 340" of the Bettis Reactor Engineering School are presented. Topics covered include: review of elementary strength of materials, fundamentals of elasticity theory, two-dimensional problems in elasticity, strain energy methods, torsion of noncircular cylinders, flat plate theory, thin shell theory, and thermal stresses. Emphasis is placed on reactor applications in illustrating the theory. Examples presented were drawn from the Shippingport Pressurized Water Reactor. (M.C.G.)

**19588** USE OF THE REACTORS IN FORTENAY-AUX-ROSES FOR STUDY OF SHIELDING PROBLEMS. R. Beauge, J. Blaud, P. Lafore, and J. Rastoin (Centre d'Études Nucléaires, Fontenay-Aux-Roses, France). Atompraxis, 9: 52-8(Feb. 1963). (In French)

It is explained why it is important, in designing a reactor, to know the radiation level in the various shielding layers. Before the shielding can be calculated with sufficient accuracy, these factors must be theoretically understood; the effective differential cross sections for elastic and inelastic interactions must also be known much better than they are at present. Since present theories are not yet certain, and serve mainly as guide-lines for experimental studies, model tests play an important part in radiation-protection research. Considerations governing the choice of particular experimental equipment and the equipment are described. The first experiments were made with Zoë, a natural uranium heavy-water reactor with an output of 150 kw and a 90-cm graphite reflector. In 1954 the construction of the experimental unit Naïade I was decided upon. A sheet of natural uranium with a surface of 1 $m^2$ and a thickness of 2 cm was bombarded with thermal neutrons from Zoë. The zone in which fission takes place can be determined by screening the neutron beam. Measurement of effective cross sections and test measurement of models can be made under water in an aluminium container. The planning and execution of the tests made with these two installations are closely described, as well as those made with Triton I, a swimming-pool reactor (18.30 × 6.00 × 9.95 m) with an output of 1 to 2 Mw. Triton I was designed for radiation-protection studies and can be used for large-sized test objects. The reactor Triton II and the attachment unit Naïade II, with their instrumentation, and with test models are described. (auth)

**19589** A STUDY OF DUAL SENSING IN REACTOR CONTROLS. C. L. Rogers and C. H. Weaver (Auburn Univ., Ala.). Commun. Electron., No. 63, 344-7(Nov. 1962).

A problem of dual sensing is postulated wherein a reactor power level is monitored with two unlike sensing devices: a slow sensor, and a fast sensor that is subject to error due to drift. An error channel, designed to combine the outputs of the two sensors so as to eliminate the undesirable characteristics of each and yield a combined output more satisfactory than that realizable from either sensor operating alone, was studied both analytically and experimentally. (auth)

**19590** THE NUCLEAR REACTOR AS A CONTROLLED SYSTEM. Pavel Kovanic. Elektrotech. Obzor, 51: No. 2, 70-5(1962).

Consideration is given to problems of reactor control physics. Reactor kinetics, reactor dynamics depending on the reactor state, and special characteristics of the reactor as a controlled system are listed as basic prerequisites for calculating and designing reactor control systems. Simplified expressions are derived for the reactor kinetic equation and the transfer functions of a critical reactor. The Laplace-Wagner transform is used to formulate reactivity-power transfers, and the dependence of these transfers on the reactor state and on the amplitude of deviation from the quasi-steady state are determined as well as their correlations with the initial neutron-power transfer. The reactor is considered a linear system for mere reproduction of neutrons and infringed by feedback, and the output of the reactor is controlled by a variation of the feedback. Based on the derived relations, the characteristics of a reactor as a controlled system, such as possibilities for increasing and reducing the reactor output by varying the reactivity (feedback), are discussed and some concepts such as reactor period and reactor shutdown are explained. (P.C.H.)

**19591** CRITICAL SIZE AND FLUX DISTRIBUTION IN A PLANE HOMOGENEOUS REACTOR AT POWER LEVEL. H. B. Smets (European Nuclear Energy Agency, Paris). Energia Nucl. (Milan), 10: 65-8(Feb. 1963). (In English)

The flux distribution of a plane homogeneous reactor at power level is proved to have one maximum and no analytic minimum when the buckling decreases with flux. The maximum flux is bounded and the critical size increases when the maximum flux increases. (auth)

**19592** OPTIMIZATION STUDIES FOR A GRAPHITE MODERATED REACTOR USING TUBULAR FUEL ELEMENTS. L. Cornaggia, G. Ghilardotti, and M. Rizzon (AGIP Nucleare, Milan). Energia Nucl. (Milan), 10: 69-84(Feb. 1963). (In English)

An optimization study is described which was carried out at Agip Nucleare as part of a program to explore the potential of a graphite moderated reactor using tubular fuel elements. The aim of the study was to determine a set of optimum values of the leading project variables which would give the minimum generation cost per unit of power sent out, and to investigate the effect, on the choice of the optimum values, of varying the output of the station and of

changing the economic conditions. The optimization procedure which was set up for this study is given; the assumptions, the methods, and the results are discussed. (auth)

**19593** THE CONTROL OF NUCLEAR POWER REACTORS BY MEANS OF MAGNETIC AMPLIFIERS. M. J. Craddock (Dawe Instruments, Ltd., London) and J. A. Purdie. J. Brit. Inst. Radio Engrs., 24: 427-39(Dec. 1962).

Magnetic amplifiers are suitable for use as amplifying elements in the main temperature control loops of nuclear power reactors. The control problems encountered are discussed and a basic temperature controller and three practical designs based on this controller are described. An indication of the expected reliability of these systems is given, based on experience with similar amplifiers in aircraft applications. (auth)

**19594** REACTIVITY MEASUREMENT USING PSEUDO-RANDOM SOURCE EXCITATION. T. E. Stern (Centre d'Études Nucléaires, Saclay, France), A. Blaquiere, and J. Valat. J. Nucl. Energy, Pts. A and B, 16: 499-508(Nov.-Dec. 1962). (In English)

A method of reactivity measurement in the far subcritical range, using a neutron source modulated in a noise-like manner, is presented. Reactivity is estimated by examining the impulse response of the reactor, which is measured by a digital cross-correlation technique. It appears that this method has several advantages over pulsed neutron methods. The experiment can be realized using a commercially available neutron source and some fairly simple pulse circuitry. Statistical analysis indicates that reasonable experimental accuracy can be achieved in a relatively short observation interval. (auth)

**19595** A MODEL WITH CONTINUOUS FUEL ELEMENT FLOW-THROUGH FOR BURN-UP IN A CYLINDRICAL REACTOR. H. Kiesewetter and H. Marbach (VEB Entwichlung und Projektierung Kerntechnischer Anlagen, Berlin). Kernenergie, 5: 824-9(Dec. 1962). (In German)

A model discussed by K. Meyer and E. Griepentrog for the burn-up in a cylindrical reactor with continuous fuel element flow-through from the exterior to the interior was extensively expanded so that in place of the velocity profiling, constant flow-through velocity was assumed. In the framework of this model, the dependence of the burn-up and flux distribution on the height was calculated. (tr-auth)

**19596** THE USE OF CONCRETE IN NUCLEAR ENGINEERING. Hsien-hsiung Lin. K'o Hsueh Ta Chung, No. 1, 9(1962).

It was discovered that concrete mixed with higher density brown iron ores and heavy spar becomes a kind of anti-radiation heavy concrete. It is believed that this kind of concrete may find wide applications in all branches of nuclear engineering. (P.C.H.)

**19597** A STUDY OF PLUTONIUM RECYCLE IN A GAS-COOLED, GRAPHITE-MODERATED REACTOR. [PART] II. Kunihiko Uematsu (Kyoto Univ.). Nippon Genshiryoku Gakkaishi, 5: 96-103(Feb. 1963). (In English)

The modified bidirectional fuel management method on plutonium recycle in a gas-cooled and graphite-moderated reactor was investigated. The modified bidirectional fuel management was designed so that the fresher fuel and the more burned fuel existed at the outer and inner regions of the reactor, respectively, to reduce the peak to average ratio of power density. This fueling method was effective to reduce the peak to average ratio of power density without sacrificing much burn-up of the fuel. The optimum irradiation control factors, A's, were at around 0.5 and 0.3 for natural uranium feed and 1.0 at. % enriched uranium feed, respectively. (auth)

**19598** CALCULATION OF THE $\gamma$-DOSE RATE DISTRIBUTION FROM THE RADIOACTIVE CLOUD IN A REACTOR ACCIDENT. Masayoshi Tsunokawa and Toshio Aoki (Japan Atomic Energy Research Inst., Tokyo). Nippon Genshiryoku Gakkaishi, 5: 110-19(Feb. 1963). (In English)

A method of numerical calculation of the $\gamma$-dose rate from the radioactive cloud was devised under the supposition that the distribution of the cloud is uniform along the flow direction; the relative error due to the supposition is less than 5%. This method is capable of acquiring more accurate values than by the other calculations under the assumptions like the circle-like cross-wind section of the cloud and/or the neglecting of the build-up phenomena. Actual calculations were made graphically to save time and effort efficiently. As the result of this method, the $\gamma$-dose rate distributions for the fission products cloud and the $Ar^{41}$ cloud were obtained. This method of estimating $\gamma$-dose rate distributions was verified by the experiments using $Ar^{41}$ cloud dispersion (at JAERI, in 1961). (auth)

**19599** THE DETERMINATION OF ATOM PER CENT FISSION IN URANIUM FUEL. B. F. Rider and C. P. Ruiz (General Electric Co.. Pleasanton, Calif.). Progr. Nucl. Energy, Ser. IX, 3: 25-59(1962).

There are three methods for determining the burnup: measurement of the amount of fission products produced, measurement of the fuel isotopic composition before and after irradiation, and nondestructive measurement, e.g., calorimetry or integrated flux monitoring. Each of these methods is described in detail, and sample calculations are given. The problems, errors, and uncertainties of each method are discussed. (D.L.C.)

**19600** REACTOR INSTRUMENTATION. Eberhard Steudel (Laboratorium für Betriebskontrollgeräte, Heiligenhaus, Ger.). VDI (Ver. Deut. Ing.) Z., 105: 171-4 (Feb. 1, 1963). (In German)

The design and operation of instrumentation for computer-regulated reactors are described. Instruments for protection in fast-period switching of reactors is also described. Schematic diagrams are included. (M.C.G.)

**19601** A GRAPHICAL METHOD OF SOLUTION OF CRITICAL EQUATIONS FOR THERMAL REACTORS. Tadeusz Swierzawski and Tadeusz Bes. Zeszyty Nauk. Politech. Slask., No. 30, Energet. No. 5, 3-19(1961).

Critical equations of thermal reactors are derived by four methods: the effective diffusion coefficient; two groups of neutrons; Fermi age; and single neutron group. The critical equation for the case of a hydrogen moderator is also given. The expressions were used to calculate the probability, $P_m$, that moderated neutrons will not escape from a system with finite linear dimensions. The solutions of the critical equations are given in the form of a nomogram in which $k_\infty$, $P_m$ and $L^2/k_\infty\tau$ are plotted as functions of $B^2\tau$ for the above cases where $k_\infty$ is the infinite multiplication constant, $\tau$ is the Fermi age, L is the diffusion length, and $B^2$ is the reactor parameter (buckling) in the wave equation $\nabla^2 n(\bar{r}) = -B^2 n(\bar{r})$ in which $n(\bar{r})$ is the neutron concentration. The nomogram can also be used to determine the nonleakage probability in the case of moderation from the fission energy to the resonance energy, the nonleakage probability in the case of moderation from the resonance energy to the thermal energy, and the nonleakage probability for thermal neutrons. (OTS)

**19602** WASTE MANAGEMENT IMPLICATIONS IN NUCLEAR SITE SELECTION. J. F. Honstead and J. Beranek (International Atomic Energy Agency, Vienna). IAEA Preprint No. SM-39/46. (In English)

To be published in Proceedings of the IAEA Symposium on Criteria for Guidance in the Selection of Sites for the Construction of Reactors and Nuclear Research Centres, Bombay, India, 11-15 March, 1963.

The part played by waste management considerations is discussed with particular emphasis on the interaction of site characteristics with waste management operations. In general, site selection will ultimately be guided by other factors, but the decision can have considerable influence on the waste problem, including the cost of the operation. Three general philosophies are followed in dealing with waste problems: absolute containment of hazardous quantities of radioisotopes, delay storage of short-lived isotopes to permit decay, and discharge of waste water containing sub-hazardous concentrations of radioisotopes with assurance of safe dispersal in the environment. Each of these philosophies is affected to some degree by particular characteristics of the site, a study of the selected site providing the proper basis for designing the appropriate waste management system. The information that may be useful in an evaluation of the consequences of waste management operations on several local environments is discussed. In examining surface streams near the installation, it is suggested that a survey be made of the utilization of the water on a seasonal basis, and attention be directed toward regulatory, administrative, and public relations problems that may arise. In addition, technical information should be obtained concerning the physical characteristics of the stream. Similar information should be obtained with regard to the ground surface and ground water where contamination might become a problem as a result of accident or malfunctioning of the waste handling operations. These studies should continue as monitoring programmes after the facility is constructed. (auth)

**19603** CIVIL ENGINEERING PROBLEMS IN SELECTING SITES FOR REACTORS AND NUCLEAR RESEARCH CENTRES. S. Noreña de la Camara (Junta de Energía Nuclear, Madrid). IAEA Preprint No. SM-39/34. 22p. (In Spanish)

To be published in Proceedings of the IAEA Symposium on Criteria for Guidance in the Selection of Sites for the Construction of Reactors and Nuclear Research Centres, Bombay, India, 11-15 March, 1963.

Attention is drawn to the importance of co-operation with the civil engineer in selecting sites for reactors and nuclear research centers. Consideration is given to various civil engineering problems relating to the construction of power reactors and nuclear research centres, such as: foundations: types, strength, bases; ground water: construction problems, protection against seepage; communications: roads, railways, aerodromes, heliports; services: water, electricity, gas, etc.; special buildings; and ventilation stacks. Recommendations are made regarding the obtaining of data for costing the various techniques which could be applied to solving the above problems a comparison of which would facilitate the selection of the most suitable solution in each case. (auth)

**19604** SITE SELECTION CRITERIA IN SWEDISH PRACTICE. L. Carlbom (Aktiebolaget Atomenergi, Stockholm). IAEA Preprint No. SM-39/13. 18p. (In English)

To be published in Proceedings of the IAEA Symposium on Criteria for Guidance in the Selection of Sites for the Construction of Reactors and Nuclear Research Centres, Bombay, India, 11-15 March, 1963.

The site selection criteria used in Sweden have been similar to those used in other countries. Practical experiences of the applications of the criteria are discussed with special reference to some not quite ordinary siting situations originating in the use of a reactor for district heating purposes, and the use of underground reactor buildings. The relative merits of some siting criteria are discussed. (auth)

**19605** MODERATOR ELEMENTS FOR UNIFORM POWER NUCLEAR REACTOR. Ralph Balent (to U. S. Atomic Energy Commission). U. S. Patent 3,081,247. Mar. 12, 1963.

This patent describes a method of obtaining a flatter flux and more uniform power generation across the core of a nuclear reactor. The method comprises using moderator elements having differing moderating strength. The elements have an increasing amount of the better moderating material as a function of radial and/or axial distance from the reactor core center. (AEC)

**19606** DETECTION OF BURST JACKETS IN NUCLEAR REACTORS COOLED BY A PLURALITY OF GASEOUS STREAMS. Jean Goupil (to Commissariat a l'Energie Atomique). U. S. Patent 3,084,251. Apr. 2, 1963. Priority date Apr. 26, 1958.

A system for monitoring a group of several gaseous coolant channels with a single detector is designed which effects the switching in a static way. In this system, the radioactive ions in each stream are collected on an electrode and then released to the detector successively and cyclically by grounding the electrode. An electronic memory device is provided to eliminate the continuous, long-lived radioactivity component from the ion count. (D.L.C.)

**19607** MONITORING OF FISSION PRODUCTS IN A GASEOUS STREAM, PARTICULARLY FOR DETECTING BURST SLUGS IN NUCLEAR REACTORS. Jean Goupil, Jean Graftieaux, and Jean Megy (to Commissariat a l'Energie Atomique). U. S. Patent 3,084,252. Apr. 2, 1963. Priority date, June 23, 1958, France.

A device is designed for determining the content of short-lived fission products in a gaseous stream. The device comprises a decay chamber, a drum, a collecting conduit with a wall section formed by the drum periphery, and means for passing the stream through the decay chamber and collecting conduit. A radiation detector is located adjacent to the drum periphery, and means is provided for moving successive areas of the drum into the front of the detector. (D.L.C.)

**19608** BURST JACKET DETECTION IN NEUTRONIC REACTORS. Jean Goupil, Jean Mégy, and André Roguin (to Commissariat a l'Energie Atomique). U. S. Patent 3,084,254. Apr. 2, 1963. Priority date Oct. 26, 1957, France.

A system for detecting leaks in jacketed fuel elements in a reactor is designed with means for immediate detection of such leaks. In this system, the actual activity of each effluent stream leaving the core is measured and compared successively with a reference activity corrected to the actual power of the reactor. (D.L.C.)

## Power Reactors

*Refer also to abstracts 18400 and 18443.*

**19609** (AGN-TM-400) ANALOG COMPUTER STUDIES OF THE ML-1 POWER PLANT. D. V. Calamore, D. H. Crimmins, and E. Tobey (Aerojet-General Nucleonics, San

Ramon, Calif.). Dec. 1962. Second Printing Mar. 1963. Contract AT(10-1)-880. 148p.

The development and operation of an analog model of the ML-1 are described. The ML-1 analog model was used for detailed investigation of the operational characteristics of the ML-1. All normal operations and many abnormal operations of the ML-1 can be simulated on this analog model. The components of the plant were described in sufficient mathematical detail so that the model will simulate operations over the full specified ambient temperature range (−65 to +150°F). The reactor for the ML-1 achieved initial criticality in March 1961, and operation of the power plant was achieved in September 1962. The analog model was used extensively to investigate the behavior of the plant, and as an adjunct to training reactor operators and for testing operational procedures. (auth)

**19610** (ANL-6692) A RETROSPECTIVE ANALYSIS OF ASPECTS OF THE ALPR (SL-1) DESIGN. W. J. Kann and D. H. Shaftman (Argonne National Lab., Ill.). Nov. 1962. Contract W-31-109-eng-38. 52p.

Design, testing, and early operation of the Argonne Low Power Reactor (SL-1) that was subsequently destroyed in a nuclear incident are reviewed. Motives determining the design of the control system are explained; and information from tests, operation, and the incident itself is analyzed for the purpose of improving reactor design and operation. (D.C.W.)

**19611** (DP-825) HEAVY WATER MODERATED POWER REACTORS. PROGRESS REPORT, JANUARY 1963. R. R. Hood and L. Isakoff, comps. (Du Pont de Nemours (E. I.). & Co. Atomic Energy Div., Wilmington, Del.). Feb. 1963. Contract AT(07-2)-1. 54p.

The Heavy Water Components Test Reactor (HWCTR) was operated most of the month at a power level of about 40 Mw for irradiation tests of various types of fuel assemblies. During reactor operation, a cladding failure occurred in an assembly of unalloyed U tubes in Zircaloy sheaths. This was the second such failure in recent weeks; therefore, all other U metal assemblies were removed from the HWCTR pending identification of the cause of the failures. An irradiation test of two 2-in.-OD tubes of mechanically compacted uranium oxide in the Vallecitos Boiling Water Reactor was concluded at an average exposure of 3000 Mwd/t. Results of a study of U utilization indicate that under the combined converter-breeder economy postulated for the U. S. by the AEC, less than half as much U would have to be mined to support $D_2O$ converter reactors to the year 2000 than would be required for $H_2O$ converters. A reference design was developed by cost optimization techniques for a 300 Mwe organic-cooled, $D_2O$-moderated reactor fueled with slightly enriched tubes of UC. (auth)

**19612** (GA-1210 and Add.) HAZARDS SUMMARY REPORT FOR THE HTGR CRITICAL FACILITY AND ADDENDUM. J. R. Brown, D. C. Pound, and J. B. Sampson (General Atomic Div. General Dynamics Corp., San Diego, Calif.). Feb. 11, 1960. Contract AT(04-3)-314. 99p.

A summary of the safeguards in the HTGR development program is presented. Experiments are planned to evaluate lattice parameters, worth of control-rod designs, resonance integrals of thorium mixtures in graphite, temperature coefficient associated with Doppler broadening of Th resonances, thermal-neutron spectra near temperature discontinuities and control rods, power distribution around control rods, and reactivity coefficients of materials in a reactor spectrum typical of HTGR. (J.R.D.)

**19613** (GA-3128) MARITIME GAS-COOLED REACTOR PROGRAM STATUS REPORT. (General Dynamics Corp. Electric Boat Div., Groton, Conn.). Apr. 30, 1961. Contract AT(04-3)-187. 51p.

The current status of the MGCR program is summarized. Each specific area is discussed individually in sections on rotating machinery development, lubrication and sealing system, cycle analysis, propulsion-plant heat exchanger development, valve development, duct development, materials testing, control system analysis, fluid-mechanical system development, electric system development, shielding, and properties and purification of coolant gas. (J.R.D.)

**19614** (GA-3799) CORRELATION OF CALCULATIONS AND EXPERIMENTAL MEASUREMENTS MADE USING A PARTIAL CORE MOCKUP (CRITICAL ASSEMBLY) OF THE PEACH BOTTOM HTGR. J. R. Brown, M. K. Drake, and K. R. Van Howe (General Atomic Div. General Dynamics Corp., San Diego, Calif.). Mar. 5, 1963. Contract AT(04-3)-314. 65p.

The development of calculational and analytical techniques and input data for specification of Peach Bottom HTGR core loading is discussed. Results obtained from experimental measurements made in the critical assembly constructed to test these techniques are included and compared with results obtained by the calculational methods. (J.R.D.)

**19615** (GAMD-3977) PEACH BOTTOM HTGR EMERGENCY COOLING ACCIDENT TEMPERATURES AND THERMAL RELEASE OF NUCLEAR POISONS AND RADIOACTIVE NUCLIDES. J. A. Landoni and T. R. Moffette (General Atomic Div. General Dynamics Corp., San Diego, Calif.). Jan. 30, 1963. Contract AT(04-3)-314. 89p.

Analysis of a postulated accident involving loss of forced circulation in both main coolant loops, permitting heat removal only by the emergency cooling water coils that line the reactor cavity surrounding the reactor vessel is presented. A description concerning the thermal release of fission products and nuclear poisons from the active region of the core is presented along with discussion of condensation and transpiration from the top reflector region and poison-removal-associated reactivity changes. The removal of particulate activity by air filters from the plant containment atmosphere is also discussed along with activity leakage, off-site dosages, and reactor and core transient conditions during such an accident. A study of permissible delay in emergency cooling system startup is summarized. (J.R.D.)

**19616** (IDO-16835) REACTOR CORE THERMOCOUPLE LOCATIONS (EOCR INITIAL CORE). R. G. Young (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). Jan. 21, 1963. Contract AT(10-1)-205. 51p.

A fundamental heat transfer analysis of a plate-type reactor fuel element is applied, along with practical considerations, to determine the location of thermocouples to be attached to fuel plates in the EOCR core. The FTL sample and eight core driver elements instrumented with thermocouples will provide data necessary to evaluate core performance. Temperature indication will be used to monitor and attempt to control fuel plate fouling of the initial core. The selection of the elements to be instrumented and location of the thermocouples are presented. (H.G.G.)

**19617** (IDO-28578) HEAT TRANSFER AND FLUID FLOW STUDIES WITH BOUNDARY LAYER TURBULENCE PROMOTERS. N. Kattchee and W. V. Mackewicz (Aerojet-General Nucleonics, San Ramon, Calif.). Feb. 1963. Contract [AT-(10-1)-880]. 57p.

An investigation of the heat transfer and fluid flow char-

acteristics of fuel elements designed for the second core of the ML-1 gas-cooled reactor is described. Boundary layer turbulence promoters were placed on the heat transfer surfaces of the 19 pins of a fuel element; and heat transfer fluid flow, mass transfer, and flow visualization tests were performed. Local, as well as average, results were obtained. By varying the pitch and the height of the turbulence promoters, it was shown that the heat transfer rate can be increased by approximately 100% without significantly changing pumping power or the overall geometry of the fuel elements. These results were produced by locally separated boundary flow conditions in the vicinity of the turbulence promoters. (auth)

**19618** (JAERI-1042) STABILITY ANALYSIS OF CONTROL SYSTEM FOR BRITISH TYPE POWER REACTORS. N. Suda and J. Miida (Japan Atomic Energy Research Inst., Tokyo). Sept. 1962. 48p.

Since the British type power reactor is unstable owing to the positive temperature coefficient of reactivity, special considerations are required in the design of the control system for such power reactors. Stability analyses of the system are made assuming types of control such as continuous, continuous with saturation, discontinuous, continuous with tachometer feedback, and continuous with rod position feedback. The generalized Nyquist's stability criterion and Kochenburger's describing function method are applied. It is concluded that the continuous system is unstable, when the controller gain is either too high or too low and that the saturation in the control rod speed does not affect the system response significantly. It is also concluded that when the discontinuous control is adopted, the system either diverges or undergoes sustained oscillations, corresponding to the stable limit cycles and introduction of tachometer feedback has little effect on the system stability. System responses are improved by application of rod position feedback. (auth)

**19619** (LADC-5458) CRYOGENIC TECHNOLOGY IN THE NUCLEAR ROCKET PROGRAM. E. F. Hammel (Los Alamos Scientific Lab., N. Mex.). [1962]. Contract [W-7405-eng-36]. 14p.

Nuclear rocket development problems have resulted primarily from the stringent operational requirements of designing a reactor with optimized parameters of core temperature, rapid start-up capability, ability to withstand extreme temperature gradients, and minimum weight. Disasterous consequences resulting from the entrance of appreciable amounts of liquid hydrogen in the reactor core during start up was feared. Efforts to program the start-up such as to increase the reactor power simultaneously with the flow rate to prevent two-phase hydrogen from entering the reactor core were attempted. The heat input into the propellant was adjusted as it progressed sequentially through the various portions of the reactor such that the hydrogen entering the reactor core remained well above its critical temperature (33°K) during the period that the core inlet pressure was < the critical pressure of hydrogen (12.9 atm). A set of hydrodynamic and heat transfer equations were developed using the transport properties and heat transfer data for fluid hydrogen to produce the necessary start-up program for the reactor. Tests prove that it is possible to start up a reactor on liquid hydrogen. (H.G.G.)

**19620** (NAA-SR-Memo-7594) RADIOGRAPHIC MEASUREMENTS OF SNAP FUEL ELEMENT END GAPS. R. C. Barry (Atomics International Div. of North American Aviation, Inc., Canoga Park, Calif.). Dec. 7, 1962. Contract [AT(11-1)-Gen-8]. 7p.

A nondestructive method was developed for measuring the spacings at the ends of fuel rods in completed SNAP fuel elements. A precisely aligned radiographic technique is employed to form an undistorted image on extra fine grain radiographic film. The end gap is then measured with a 20 x measuring microscope. The radiographic technique, alignment gages, and film reading methods are described for measuring gaps at the blend end and blind end of the fuel elements. The accuracy of measurements at the blend end ranges from ±0.0005 in. for spacings up to 0.010 in. to ±0.002 in. for spacings above 0.025 in. The accuracy at the blind end is about one-half that at the blend end. (auth)

**19621** (NAA-SR-Memo-7878) ECONOMICS OF THE 300 MWE ORGANIC MODERATED AND COOLED REACTOR NUCLEAR POWER PLANT. G. S. Budney (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Dec. 15, 1962. Contract AT(11-1)-Gen-8. 32p.

The unit energy cost of the 300-Mwe OMCR nuclear power plant was estimated, based on AEC ground rules. The analysis indicates that a plant of this size can be constructed for a cost of $170/kwe net, and that the estimated total energy cost from the plant under investor-owned public utility financing is 6.39 mills/kwh. This figure is competitive with energy costs from plants of comparable size in the higher fuel cost regions of the country. Data are also presented on the effect of other variables on energy cost. These include variables such as capacity factor, fuel element fabrication cost, fuel burnup, private fuel ownership, and fixed charges associated with municipally owned public utilities. (auth)

**19622** (NAA-SR-Memo-7879) REACTIVITY CHANGES DUE TO FUEL MOVEMENT IN THE THIRD CORE OF THE SRE. D. I. Monnie (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Nov. 1, 1962. Contract [AT(11-1)-Gen-8]. 8p.

A report is presented to show the theoretical results of reactivity changes resulting from fuel movement in the third core of the SRE. A hydraulic pressure or thermal gradient across the fuel elements and the fuel cluster may cause sufficient fuel element bowing or off-center displacement of the fuel cluster to produce undesirable changes in the reactivity. The maximum reactivity changes resulting from fuel element bowing and fuel cluster displacement can be restricted by a fuel cluster spacer and support assembly. Displacement of bowing of the fuel within the fuel jacket may also cause undesirable reactivity changes which can be restricted by a fuel spacer. The results presented indicate the tolerances required for the fuel cluster spacer and support assembly and the tolerance required between the fuel and fuel jacket. Various means of reducing the displacement and bowing coefficients are also discussed. (auth)

**19623** (NAA-SR-Memo-8011) A METHOD OF THERMAL ANALYSIS AND ORIFICE ADJUSTMENT CALCULATION FOR THE PNPF REACTOR CORE. J. R. Hume (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Dec. 28, 1962. Contract [AT (11-1)-Gen-8]. 73p.

A procedure for the field (on-site) performance of a routine thermal analysis of the core was developed and is reported. Previous calculations of core power distribution were utilized to develop all the information needed to compute maximum surface temperatures and maximum heat flux in each element. The procedure makes it possible to perform the calculations on a desk computer with the assistance of the graphed and tabulated data which are

provided. The procedure presented was used with the additional information included to determine an orificing zone arrangement proposed for the initial core. The resulting maximum fuel surface temperatures will be less than 723°F. Although the original orificing mode was not expressly reviewed in the Safeguards Reports, certain features were implied in the analyses reported. The new orifice program was examined to determine if there are new questions of safety. It was concluded that the previous considerations remain valid under the operational requirements proposed. (auth)

**19624** (NAA-SR-Memo-8022) OMRE ADSORPTION — GFY 1962. W. W. Davis (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Dec. 18, 1962. Contract [AT(11-1)-Gen-8]. 24p.

The OMRE adsorption system located in the impurities removal loop (IRL) received system checkout and preliminary testing during fiscal year 1962. The major results with respect to the coolant cleanup effected during these preliminary tests are reported. Based on these results and previous adsorption work, an operating mode is proposed for OMRE adsorbers when continuously processing reactor coolant. It was established that high E/A values may be expected when processing relatively clean coolant. An E/A in excess of 2000 was obtained in one OMRE run with processing coolant containing less than 10 ppm ash and less than 5 mg PCFT. Based on estimated equilibrium HHB source rates an operating cycle of 185 thermal megawatt days between adsorbent changes is recommended for OMRE Core III-B operation. At a constant power level of 5 TMW this corresponds to a one month cycle time. A statistical analysis of adsorber inlet and effluent coolant showed that adsorbent bleedthrough is not a problem. In addition, it was concluded that a guard filter cleaning effect experienced in some work was not evident in OMRE ash or PCFT data. (auth)

**19625** (NAA-SR-Memo-8041) CONCERNING THE HAZARD OF FREON VAPOR IN THE SRE GALLERY GAS. Charles R. F. Smith (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Dec. 20, 1962. Contract [AT(11-1)-Gen-8]. 17p.

The potential hazard to the SRE Heat Exchange System involving Freon vapor in the gallery gas and an exothermic reaction between Freon and molten Na is considered. This danger is shown to be negligible. The rate of this reaction would be limited by the high dilution of Freon in $N_2$, the maximum concentration obtainable being less than 2 volume percent Freon. The danger of corrosion of gallery components by Freon vapors is also examined. This danger appears to be very slight under present operating conditions. Much contradictory information on the corrosiveness of Freon vapors has appeared in the literature. The literature most pertinent to the conditions in the heat exchange galleries indicated that corrosion of steel by Freon-12 vapor is slight at 1050°F, rapid at 1400°F. Maximum temperatures in the galleries at this time are about 1000°F. Methods which could be used for monitoring Freon in gallery gas are described and evaluated including an ion-current device, a He leak detector, temperature measurement of the condenser, and a halide torch. Of these, the last two appear to be the most practical and the least costly. Alternatives to the use of a Freon refrigerant are considered. One of these, the use of a regenerative drying agent, appears to be attractive. (auth)

**19626** (NAA-SR-Memo-8089) CLASS A COMPONENTS. PNPF-OAP EQUIPMENT PERFORMANCE CHECK. K. D. Neff and R. R. Stiens (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Dec. 12, 1962. Contract [AT(11-1)-Gen-8]. 37p.

Standard test procedures were developed for the routine performance checking of critical components in PNPF (Piqua Nuclear Power Facility). The items of equipment covered by these procedures are the steam generator, superheater, main-coolant pumps, pressurizing pumps, shield-cooling pumps, decay-heat exchanger, decay-heat condenser, and the shield-cooling exchanger. The main objective of the tests is to detect changes in the efficiency of the centrifugal pumps, and in the overall heat transfer coefficient of the heat exchangers. (auth)

**19627** (ORNL-1407) AIRCRAFT REACTOR EXPERIMENT HAZARDS SUMMARY REPORT. W. B. Cottrell, ed. (Oak Ridge National Lab., Tenn.). Nov. 24, 1952. Contract W-7405-eng-26. 115p.

A hazards summary is presented for the Aircraft Reactor Experiment. This facility was designed primarily to test the feasibility of fluid-fuel, high-temperature, high-power-density reactors for aircraft. Design and operation of the reactor are discussed, and the nuclear and chemical hazards peculiar to it are outlined along with hazards to the surrounding area in event of failure. (J.R.D.)

**19628** (ORNL-3208) STEAM GENERATORS FOR HIGH-TEMPERATURE GAS-COOLED REACTORS. A. P. Fraas and M. N. Ozisik (Oak Ridge National Lab., Tenn.). Apr. 23, 1963. Contract W-7405-eng-26. 182p.

An analytical approach and an IBM machine code were prepared for the design of gas-cooled reactor once-through steam generators for both axial-flow and cross-flow tube matrices. The codes were applied to investigate the effects of steam generator configuration, tube diameter, extended surface, type of cooling gas, steam and gas temperature and pressure conditions, and the pumping power-to-heat removal ratio on the size, weight, and cost of steam generators. The results indicate that the least expensive and most promising unit for high-temperature high-pressure gas-cooled reactor plants employs axial-gas flow over 0.5-in.-dia bare U-tubes arranged with their axes parallel to that of the shell. The proposed design is readily adaptable to the installation of a reheater and is suited to conventional fabrication techniques. Charts are presented to facilitate the design of both axial-flow and cross-flow steam generators for gas-cooled reactor applications. (auth)

**19629** (ORNL-3261(Suppl.)) LIFETIME STUDIES FOR THE N.S. SAVANNAH REACTOR. E. E. Gross, M. L. Winton, and B. W. Colston (Oak Ridge National Lab., Tenn.). Apr. 1, 1963. Contract W-7405-eng-26. 43p.

Previous studies of the N.S. Savannah core I reactor were extended by a series of one-dimensional lifetime calculations to investigate several questions of interest in the operation of the reactor. Replacement of the two-zone loading by a single-zone loading with the inner-zone enrichment was found to have only a small effect on the calculated reactivity lifetime. The time-dependent core inventories of $U^{235}$, $Pu^{239}$, and $Pu^{241}$ for core I were calculated. Various fuel-management schemes for extending the reactivity lifetime of core I were investigated, and the data showed that the largest lifetime extension would be obtained by changing the fuel-element container material from stainless steel to Zircaloy. One-dimensional radial and one-dimensional axial "window-shade" burnup calculations were compared, and the results of the two methods were in excellent agreement with regard to the predicted core lifetime. Although the radial burnup calculation is much simplier, the window-shade calculation provides

essential information on axial power distribution and control-rod bank movements. (auth)

**19630** (ORNL-3386) ARMY REACTORS PROGRAM ANNUAL PROGRESS REPORT FOR PERIOD ENDING OCTOBER 31, 1962. (Oak Ridge National Lab., Tenn.). Apr. 10, 1963. Contract W-7405-eng-26. 127p.

Participation in the program continued to include review, inspection, and support in various areas of reactor technology. An advanced fuel irradiation test program was established that is to be conducted in the pressurized-water loop in the Oak Ridge Research Reactor. Review of the design of the MH-1A reactor was initiated. This reactor, a pressurized-water system fueled with low-enrichment bulk $UO_2$ clad with stainless steel, is being designed as a floating plant to furnish electrical energy to shore installations. Studies of the out-of-pile corrosion resistance of stainless steel brazed joints were completed. T-joint specimens of type 304 stainless steel were brazed together with 18 different alloys. Initial testing resulted in the selection of five of these alloys for extended testing, which was carried out in autoclaves with $O_2$ or $H_2-O_2$ added to the autoclave water. These alloys, General Electric alloys Nos. 81 and 75, Coast Metals alloy NP, low-melting Nicrobraz, and a Pd-base alloy, were satisfactory. Coast Metals alloy NP was selected as the reference braze material for the SM-1 fuel elements because it was more amenable to the brazing method established for this element. A method was developed for stabilizing $Eu_2O_3$ against aqueous corrosion in the event a control rod containing this material became defective in service. The method developed involves the addition of $MoO_3$ to the $Eu_2O_3$. When a mixture of $Eu_2O_3-15$ wt % $MoO_3$ is reacted, a single phase inert to aqueous corrosion, believed to be $Eu_2MoO_{12}$, is formed. The irradiation testing that was carried out on nonsintered bulk $UO_2$ fuel in the ORR pressurized-water loop was completed, and the loop is to be used for irradiation testing of advanced cermet fuel elements, as well as water chemistry experiments in support of the Army pressurized-water reactor program. The design of the cermet fuel assemblies is under way. It is expected that experimental assemblies will be placed in the loop during the spring of 1963. In the meantime, the water chemistry studies now under way will be continued. The ORR loop has operated satisfactorily since December 1959 in the ORR. This loop was designed to recirculate water at conditions up to 2500 psig, 650°F, and 80 gpm. A recent test to determine the loop heat exchanger capacity at a nominal operating temperature of 480°F indicates that it is capable of removing 300 kw. The operating experience of the loop has been very good. Water leakage is extremely low, and thus excellent control of the water chemistry is obtained. While much information on water chemistry is already available, relatively little in the way of a fundamental understanding of observed behavior has been gained, especially in connection with the important unsolved problems of the transport and deposition of corrosion products and their associated radioactivity. At the beginning of the water chemistry study in the ORR pressurized-water loop in early 1961, cooled water samples taken from the loop upstream of the ion exchangers showed relatively low activity levels during normal undisturbed loop operation compared with similar samples taken during loop startup. About 90% of the activity was removed by the purification system ion exchangers, and about two-thirds could be removed by a 0.45-$\mu$ millipore filter with a cellulose backing pad. The crud level was estimated to have been $< 0.05$ ppm during normal operation. In contrast, during loop startup, the water-borne activity level was about 50 times higher and the crud level was often several ppm; 98 to 99% of the activity was removed by the ion exchangers, and 95% could be removed by a 0.45-$\mu$ filter. After the middle of 1961, radiochemical analysis of the water samples taken upstream of the ion exchangers showed a decrease in the level of water-borne activity. These later samples generally showed a lower percentage of activity removed by a 0.45-$\mu$ filter. It appears that the normal crud level in the ORR loop since the latter part of 1961 has been 0.01 ppm or less. The loosely deposited crud on some of the surfaces of the fuel assemblies in the loop were removed and analyzed. No marked trends were found in the various specific activities with location of the fuel rod or even from one experiment to another. The crud samples collected on a filter from the loop water during a period of high crud level were studied and found to have a magnetite structure. As the oxide film on the metal surface grows, magnetite presumably is released as crud to the water. Its presence in the crud as well-developed crystallites, however, seems especially significant in view of the nearly complete absence of crud particles in the 0.01- to 0.5-$\mu$ range. The implication is that recrystallization of the magnetite occurs, and this implies that appreciable radiochemical exchange can take place between activated and nonactivated crud. In fact, the present results provide evidence that significant radiochemical exchange takes place between the two fractions of water-borne activity—the filterable crud fraction and the nonfilterable, apparently ionic, fraction. It would appear that the dissolved material is the principle agent of activity transport in well-conditioned, neutral-pH, pressurized-water systems during periods of normal operation. The transport process would consist of the liberation of activity from the in-flux-crud deposits as ionic material, which can exchange with crud deposits throughout the system. It would at the same time account for the well-crystallized appearance of the crud. A simple model was formulated that should permit analysis of this transport process. Since magnetite is a principle constituent of crud, it suggests itself as a possible filter ion-exchange medium. Experiments were performed in which high-temperature loop water was passed through a cartridge filled with magnetite. The results showed quite favorable decontamination from activity that was mostly nonfilterable. Postirradiation examinations were performed on 34 fuel specimens contained in six BMI-32 NaK-filled capsules that had been irradiated in the ETR. The fuel specimens were in the form of plates with a cermet fuel body of either $UO_2$ or UN dispersed in type 347 stainless steel along with various additions of burnable poison in the form of $B_4C$, $NbB_2$, and $ZrB_2$. These specimens were clad with type 347 stainless steel and a few specimens contained B in the frame of the specimen or a $Eu_2O_3$ cermet adjacent to the fuel cermet. The fuel was highly enriched to nominal concentrations of 26 and 40 wt % $UO_2$ and 34 wt % UN. The $UO_2$ used was either of the hydrothermal or the spherical type. Eleven of the specimens failed in degrees varying from complete disintegration to surface blistering. It is felt that these failures were attributable primarily to overheating in the capsule rather than to irradiation-damage effects. From the examination of the 23 specimens that survived the test in good condition, it was found that the 26 wt % $UO_2$ cermets could sustain a $U^{235}$ depletion of 67% with a surface temperature in the range of 600°F and maintain adequate dimensional stability and structural integrity. The burnable poison or $Eu_2O_3$ cermet cores did not appear to affect the stability of the specimens. The examination of a third SM-1 fuel assembly, S-81, is under way. This element remained in the SM-1 for 19.5 Mwyr of reactor operation. The two assemblies examined previously, S-72 and S-79, were removed after 10.5 and 16.4 Mwyr of reactor

operation. The preliminary findings with respect to element S-81 are that the outer fuel plates exhibit greater rippling than noted before, the thickness measurements of individual fuel plates vary in proportion to the axial burnup, and no matrix cracking is present. Twelve miniature stainless steel-clad specimens containing 20, 30, and 40 wt % $Eu_2O_3$ cores were inserted in the ETR for irradiation testing. Eight specimens have acquired their requested exposure and have been subjected to postirradiation examinations. These examinations revealed that the specimens underwent no dimensional or structural changes. Corrosion tests were performed on these specimens by defecting the cladding to expose the $Eu_2O_3$ and exposing these specimens to high-temperature water. The specimens swelled, and the extent of swelling was a function of the $Eu_2O_3$ loading. The irradiation exposure had little or no effect on the swelling characteristics. The autoclave water was analyzed after these tests, and the Eu content was found to be below spectrographic detection limits. During an inspection of the SM-2B fuel element at the SM-1, an area suspected of having a crack was noted on one of the welded side plates. This element was therefore examined, and it was found that the suspect area was not cracked and that the indication noted was composed of a series of fine scratches. Two pieces of equipment were developed to facilitate the postirradiation examination of fuel components. Plate-spacing measurement equipment was constructed and used, and a fission-gas-sampling apparatus was completed and used for sampling the gas in the BMI-32 capsules. Two pressure-vessel steel surveillance capsules were removed from the SM-1. One was removed after 16.4 Mwyr of reactor operation and the other was removed after 20.8 Mwyr of reactor operation. These capsules each contained three subsize Izod impact specimens made of ASTM A212, grade B, steel with six notches in each. These impact specimens were tested, and it was concluded that notch No. 2 of the impact specimens best represented the dose of the pressure vessel. The Charpy-V transition temperature increase for notch No. 2 after 20.8 Mwyr reactor exposure was determined to be 92°F. (auth)

**19631** (ORNL-3416) MARITIME REACTOR PROGRAM. Annual Progress Report for Period Ending November 30, 1962. (Oak Ridge National Lab., Tenn.). Apr. 4, 1963. Contract W-7405-eng-26. 129p.

A survey of the N. S. Savannah reactor shield was carried out during the report period. The results showed that the shield effectively meets design specifications. Tests of $I_2$ removal by a charcoal unit in the N. S. Savannah reactor emergency ventilation system using 80 to 90% water-saturated air showed a unit efficiency of 99.86 ± 0.07% at the 95% confidence level. Simplified procedures were devised for using shipboard equipment to screen personnel suspected of having body burdens of radioactive materials. Other work in connection with N. S. Savannah is reported on accidental activity release, port survey visits, and physics calculations. Continued trouble-free operation of the ORR pressurized-water loop is reported. Emphasis during the period was placed on water-borne radioactive contaminants. Advanced core developmental work was devoted to physics calculations, fuel development, fuel irradiation and postirradiation examinations, and evaluation of nonsintered $UO_2$ fuel for N. S. Savannah. (J.R.D.)

**19632** (ORNL-TM-536) EFFECT OF MAXIMUM BRINE TEMPERATURE ON THE OUTPUT OF LARGE NUCLEAR STATIONS FOR PRODUCTION OF WATER AND ELECTRICITY. I. Spiewak (Oak Ridge National Lab., Tenn.). Mar. 29, 1963. Contract [W-7405-eng-26]. 14p.

The effect of brine temperature on the cost of water from large municipally owned $D_2O$ reactor stations was investigated. It was found that water costs from 25,000 Mwt stations varied between 11.7 and 12.6¢/1000 gal in the maximum brine temperature range of 160 to 350°F. By-product electric power was sold at 1.49 mills/kwhr. The optimum size of reactors for producing combinations of 1 to 3 billion gpd and 1000 to 5000 Mwe was determined. From these optima, incremental costs of producing power and water were computed. (auth)

**19633** (PB-161062) STUDY OF THE APPLICABILITY OF COMBINING NUCLEAR REACTORS WITH SALINE WATER DISTILLATION PROCESSES. Research and Development Progress Report No. 19. D. B. Brice, M. R. Dusbabek, and C. R. Townsend (Fluor Corp., Whittier, Calif.). [nd]. Contract 14-01-001-97. 155p.

Activities in a program to select the two optimum-combination saline water reactor-conversion systems for further study and to indicate the direction of further research are reported. Results are presented of an investigation concerning the effects of power level on the cost of steam generated by natural U, heavy water-moderated and -cooled reactors. Studies of water cost from a multi-stage evaporator system are reported in which data were gathered indicating that sea water can be converted at 52 to 63 cents per thousand gallons in a 50 million gallon per day distillation plant utilizing steam from a nuclear reactor. It is also concluded that above 400 Mw the steam cost is relatively independent of power level. The two combination reactor-distillation systems which are considered optimum are the heavy water-moderated and -cooled reactor and the light water-moderated and -cooled slightly enriched reactor, incorporated with either a combination multiple-effect and multi-stage flash evaporator system or a long-tube vertical multiple-effect evaporator system. (J.R.D.)

**19634** (SRO-81) HEAVY WATER POWER REACTOR PROGRAM MONTHLY PROGRESS REPORT, MARCH 1963. (Savannah River Operations Office, AEC). 8p.

Progress is reported on various research programs. Information is included on AEC/AECL cooperative program concerning CANDU development, sintered Al products development, fluid dynamics, Zr technology, heat transfer, pile engineering, and reactor cost studies. Results of HWCTR operation are reported along with those obtained in the power demonstration program. (J.R.D.)

**19635** (TID-18314) CONTROL ROD DRIVE SYSTEM DESCRIPTION AND DESIGN CRITERIA. E. F. Palmer, comp. (Allis-Chalmers Mfg. Co. Atomic Energy Div., Washington, D. C.). May 4, 1961. Contract AT(10-1)-925. 84p. (EGCR-STUDY-II-401)

The design of the EGCR control rod drive system is described. Calculations related to the drive mechanism and shock absorber are included. (J.R.D.)

**19636** (TID-18325) SAVANNAH NUCLEAR POWER SUMMARY TEST REPORT, PHASES I AND II. (New York Shipbuilding Corp., Camden, N. J.). Nov. 3, 1961. 70p. (NSS-104)

A summary is presented of the results obtained during the prefueling test program extending over several months. The program was concluded after the successful completion of a run in which the whole plant was operated over the full range of primary system temperatures and pressures to the extent possible without the presence of fuel elements. (J.R.D.)

**19637** (TID-18390) SAVANNAH NUCLEAR POWER REACTOR OPERATIONS AT CAMDEN. Summary Test

Report. (New York Shipbuilding Corp., Camden, N. J.). Jan. 26, 1962. 31p.

A description is presented of N. S. Savannah fueling operations, the initial criticality operation, and subsequent low-power tests and operations. Results of these operations are also described. (J.R.D.)

**19638** (WAPD-MRP-102) PRESSURIZED WATER REACTOR (PWR) PROJECT TECHNICAL PROGRESS REPORT, DECEMBER 24, 1962 TO FEBRUARY 23, 1963. (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). Contract AT(11-1)-Gen-14. 111p.

Progress on the Shippingport Pressurized Water Reactor is reported. Topics covered include: core 2, core 2 seed 2, core 1 operations, reactor plant decontamination, reactor physics, metallurgy of core materials, and plant modification. (M.C.G.)

**19639** (WCAP-4185) CVTR PROJECT—CAROLINAS VIRGINIA NUCLEAR POWER ASSOCIATES, INC. MONTHLY PROGRESS REPORT, MARCH 1963. (Westinghouse Electric Corp. Atomic Power Div., Pittsburgh). Contract AT(30-1)-2289. 9p.

Post-construction research and development are reported. Included are sections on plant nuclear evaluation, sonic inspection of pressure tubes, and metallurgical examination of CVTR components. (J.R.D.)

**19640** THE PROBLEMS AND PROSPECTS OF NUCLEAR POWER. Atom, No. 77, 62-71(Mar. 1963).

The history of the British nuclear power program to date is reviewed. The potentialities and problems of certain more advanced reactor systems, including AGR and CANDU, that the United Kingdom will have to consider for the 1970's are discussed. (M.C.G.)

**19641** CONTROL AND INSTRUMENTATION FOR NUCLEAR POWER STATIONS. A. H. McQueen. Atomics, 16: No. 2, 9-14(Mar.-Apr. 1963).

The types of instrumentation and methods of control are described for a nuclear power station in operation or for power stations soon to be in operation. These power stations are Dresden, Kahl, SENN, Humboldt Bay No. 3, Big Rock Point, and JAERI. The systems for neutron monitoring, reactor in-core neutron monitoring, reactor protection, and manual reactor rod control and position indicating are described. (M.C.G.)

**19642** THE RESONANCE INSTABILITY OF THE EXPERIMENTAL BREEDER REACTOR, EBR-1. Yoshie Ebizuka and Masuo Shindo. Bull. Tokyo Inst. Technol., Spec. No. 49, 111-26(1962). (In English)

A treatment is presented of the physical mechanism of the delayed negative feedback effect which has been a matter of considerable speculation in previous instability studies. The thermal system in the reactor is treated as distributed parameter system and the reasonable interpretation of the marked phase lags associated with the effect is obtained. It is shown that the theoretically formulated transfer function for Mark II core is sufficient to permit the resonances which were observed in the oscillator experiment. The stabilized features of Mark III core are studied, comparing the results for Mark II and III cores. (auth)

**19643** PROGRESS IN WATER-MODERATED REACTORS. T. Deighton. Chem. Process Eng., 44: 138-44 (Mar. 1963).

Factors that have limited the design of the reactor core with reference to the heat removal system of a pressurized water marine reactor, of particular interest to chemical engineers, are discussed. Consideration is given to special safety measures covering decay, heat removal, and the maximum conceivable accident conditions. A typical first-generation pressurized water reactor steam-raising plant is described, and a number of modifications and improvements that should enable a future plant to be competitive with conventional propulsion are discussed. (auth)

**19644** NUCLEAR POWER STATION CONTROL. I. THE EFFECTS OF REACTIVITY VARIATIONS IN MAGNOX REACTORS. G. G. Bond (United Kingdom Atomic Energy Authority, Harwell, Berks, Eng.). Elec. Rev., 172: 89-93(Jan. 18, 1963).

The difference between civil nuclear power reactors and those at Calder Hall is considered. The basis of reactivity control is described. The effects of positive and negative temperature coefficients, xenon, and load reductions are discussed. (auth)

**19645** NUCLEAR POWER STATION CONTROL. 2. SPATIAL INSTABILITIES AND THE USE OF SECTOR RODS. G. G. Bond (United Kingdom Atomic Energy Authority, Harwell, Berks, Eng.). Elec. Rev., 172: 153-6(Jan. 25, 1963).

Radial and axial instabilities due to xenon and temperature effects in Magnox reactors are considered and the use of sector rods is described. (auth)

**19646** NUCLEAR POWER STATION OPERATION. R. J. Weeks. Elec. Rev., 172: 177-80(Feb. 1, 1963).

The operation of nuclear and conventional power stations is compared and contrasted. Topics covered include: basic control, raising the plant to full power, checking equipment and procedures, and automatic sequence control. (M.C.G.)

**19647** OPERATION AND CONTROL OF THE CHINON POWER STATION. M. Dardare and M. Lyon. Energie Nucl., 4: 582-8(Dec. 1962). (In French)

The three general functions required to operate a power plant, and especially a nuclear power plant, are control to maintain definite working conditions, automation to insure plant safety, and data processing to supply the operator at any moment with the necessary information. It is shown how these functions are fulfilled at the Chinon power plant. The technical development from EDF-1 to EDF-2 to EDF-3 is emphasized. The increasing importance of computers in the operation and control of Chinon power plants is indicated. (tr-auth)

**19648** ECONOMICS OF HEAVY WATER POWER REACTORS. J. R. Dickinson (Canadian General Electric Co., Peterborough, Ont.). Eng. J., 45: No. 10, 41-6(Oct. 1962).

Three types of the heavy-water-moderated power reactor that are part of the Canadian development program for nuclear power are discussed. Competitive sources of power and the place for nuclear power in Canadian utility systems are suggested. The interest of other countries in heavy-water power reactors is described. The advantages and disadvantages of heavy water as a moderator are listed. Heavy-water cooling, organic cooling, and fog cooling of heavy-water-moderated reactors are discussed. (M.C.G.)

**19649** PROCESS STEAM FROM CALDER HALL. W. H. Long, J. S. D. Pigott, and R. C. Williams. Engineer, 214: 525-31(Sept. 28, 1962).

The continued expansion of the Windscale and Calder site of the Atomic Energy Authority demanded an increase in steam supplies for process and space heating. To meet this demand in the most economic manner, it was decided to tap off steam from the h.p. and l.p. steam mains from the Calder reactors. When compared with new boilers, the annual saving in operating costs is estimated to be more than £200 000. This scheme is also £190 000 cheaper in capital than the installation of a new boiler plant. An additional reason for the adoption of this course was that the output

of the Calder reactors had increased so that the steam generated was more than the installed turbine capacity. (auth)

**19650** DOUNREAY FAST REACTOR. Engineer, 214: 758-60(Nov. 2, 1962).

Supporting research and development work for the Dounreay Fast Reactor is described. Topics covered include: fuel element fabrication and development, high-activity examination, fuel research, medium-activity examination laboratories, plutonium laboratory, electrical and mechanical laboratories, and liquid sodium research. (M.C.G.)

**19651** SODIUM-COOLED REACTORS: THE THORIUM EPITHERMAL REACTOR (A.E.T.R.). Donald T. Eggen (Atomics International, Canoga Park, Calif.). Ind. At., 6: 63-78(1962). (In French)

The thorium epithermal reactor used a $U^{233}$/Th fuel cycle and sodium as coolant. It operates in the spectral region above the thermal region. It permits energy production at a competitive cost, even in the U. S. where the cost of fossil fuel is particularly advantageous. In order to determine the parameters, a critical assembly with multiple zones is used. It is shown that the A.E.T.R. will be, in the epithermal region, more favorable than a thermal system. A completely nonmoderated system (50 to 200 kev) will offer, moreover, numerous advantages among which is a minimum poisoning from the fission products. This allows a higher burn-up. Other advantages, with respect to a $Pu/U^{238}$ system, are a greater freedom in the selection of geometric parameters of the core, safety, and the cost of reprocessed fuel. The disadvantage is the scarcity of $U^{233}$ for the initial fuel. (tr-auth)

**19652** FAST REACTOR DESIGN FOR ECONOMIC POWER PRODUCTION. L. R. Blake (Dounreay Experimental Reactor Establishment, Caithness, Scotland). J. Nucl. Energy, Pts. A and B, 16: 509-32(Nov.-Dec. 1962). (In English)

The main physics, engineering and safety design principles are described of a conservatively-rated 750 MW(th), 250 MW(e) power fast reactor. The estimate of capital cost is £50 – £60 per kw installed. With a coolant outlet temperature of 450°C and with the equivalent of plutonium-uranium metal fuel operating at 6 per cent average burn-up, 700°C maximum fuel temperature, the power cost in the U.K. should be 0.28 to 0.32 d/kwh, which is substantially less than with any other reactor or with conventional coal-fired plant. The cost of electrical power has three main components: (1) fuel cost; (2) interest and depreciation on capital; and (3) operating cost. The fast reactor compares with the best reactors with respect to (2) and (3) and is potentially superior with regard to fuel cost, (1). This also has three components: (1.1) interest charge on the initial fuel loading; (1.2) cost of fertile-fuel feed and of reprocessing and refabricating spent fuel; and (1.3) credit for excess plutonium produced. The fast reactor is at a disadvantage with respect to (1.1), as it requires a large quantity of highly enriched fuel for its first core, but this is offset since it needs a fertile-fuel feed only thereafter, usually depleted or natural uranium. Its main advantage is that poisoning effects of fission products are virtually absent, so burn-up is limited only by fuel element distortion. At high burn-up, about 10 per cent in metal fuel, cost (1.2) tends to zero and, as (1.3) can be greater than (1.1), it is possible for the fuel cost to be negative. A power cost of 0.2 d/kwh at 0.7 load factor should be within the bounds of possibility, given a 10 per cent burn-up metal fuel capable of operating at 750°C center temperature, or the equivalent conditions in other fuel. Even now it should be possible to achieve 6 per cent burn-up at 700°C center temperature. This is confirmed by tests, previously reported, of fuel pins to 5 per cent burn-up with no measurable distortion under more onerous conditions of power density, temperature gradient, and center temperature than in the design above. Thus it is argued that economic power is possible with the fast breeder reactor with no significant extrapolation of present knowledge; moreover, there is scope for considerable further development, particularly to higher burn-up and to higher coolant temperature, giving a station efficiency of over 40 per cent rather than 33 per cent as assumed. (auth)

**19653** A TRIAL DESIGN OF NUCLEAR POWERED OCEANOGRAPHIC AND SUPPLY SHIP. Muneo Yamaguchi (Mitsubishi Ship Building and Eng. Co., Ltd., Japan). Nippon Genshiryoku Gakkaishi, 5: 144-53(Feb. 1963). (In Japanese)

In 1961, the Japan Nuclear Ship Research Association made a contract with the Science and Technical Agency of Japanese Government, on the trial design of nuclear powered oceanographic and supply ship as one of the latter's projects for the peaceful use of nuclear power. The association organized a committee to supervise the designing in which the author presided as the chairman. An outline description is given of the design which was completed in July, 1962. The ship has 6,350 gross tonnage and is equipped with a water-cooled, water-moderated pressurized water reactor which has 35 Mw thermal output and produces 10,000 shp. The weight of the trial design was not placed in developing a new type of marine reactor nor in detailing about conventional part of a ship's design. The main object was to study the feasibility of a comparatively small nuclear powered vessel with a proved-type reactor with satisfactory safety and also to find out where would the problems, technological and legal lie if such a ship was constructed in a very near future. (auth)

**19654** DIPHENYL SHOWS ADVANTAGES FOR 1. DIRECT-CYCLE NUCLEAR PLANTS 2. DUAL-PURPOSE PLANTS. D. W. Bareis and G. S. Leighton. Power Eng., 66: 43-5(Sept. 1962).

Uses of diphenyl to provide economical power in either fossil-fueled or nuclear power plants are discussed. It is shown that diphenyl has excellent energy conversion and heat transfer properties. An energy conversion system using diphenyl is described and diagrammed. Economic comparisons were made for 42,000 and 306,000 kw(e) fossil-fueled and nuclear power plants using steam and diphenyl. (M.C.G.)

**19655** NUCLEAR POWER PLANTS AND MOBILE NUCLEAR POWER STATIONS. Guenter Wiesenack (Technische Uberwachungs-Vereine, Essen, Ger.). VDI (Ver. Deut. Ing.) Z., 105: 165-70(Feb. 1, 1963). (In German)

Both stationary and mobile nuclear power plants and research reactors for nuclear power development are discussed. Those in operation and under construction by Euratom, Federal Republic of Germany, England, France, Italy, and USA are described. (M.C.G.)

**19656** CIVILIAN NUCLEAR POWER. ECONOMIC ISSUES AND POLICY FORMATION. Philip Mullenbach. New York, The Twentieth Century Fund, Inc., 1963. 415p. $8.50.

An evaluation of policy formation is given which is based on economic analysis of the issues underlying power reactor development during the period 1953 to 1961. The intimate interaction of reactor technology and administrative economic policies is described. The debated economic need for nuclear power in the U. S. is reviewed against the

background of nuclear resources and development programs. The expressed foreign needs and programs are analyzed. Finally, a few economic guidelines are given. It is felt that the U. S. can bring the crosspurposes and conflicts in its nuclear power program (e.g., private vs public power and short-term fuel vs converter fuel) into balance. (D.L.C.)

**19657** ATOMIC FORUM, 1962. Achievements—Policies—Goals. Proceedings of The Annual Conference, November 26, 27, 28, 1962, Washington, D. C. A Forum Report. Wadsworth Likely and Ruth Dropkin, eds. New York, Atomic Industrial Forum, Inc., 1963. 186p. $7.50.

Forty-two papers and panel discussions are presented on various aspects of the atomic energy industry. Topics discussed include reactor operating experience, status of individual power reactor projects, cost trends in conventional fuels, space power, government policies, labor aspects, use of uranium, nuclear power abroad, and economics of station power. (D.L.C.)

**19658** LEAK-TIGHTNESS OF POWER REACTOR AND OTHER NUCLEAR INSTALLATION BUILDINGS. Alicia Crespi (Junta de Energia Nuclear, Madrid). IAEA Preprint No. SM-39/35. 23p. (In Spanish)

To be published in Proceedings of the IAEA Symposium on Criteria for Guidance in the Selection of Sites for the Construction of Reactors and Nuclear Research Centres, Bombay, India, 11-15 March, 1963.

A description is given of current criteria governing leak-tightness of power reactor buildings and the effect on those criteria of reactor type and site. Consideration is also given to standards of leak-tightness for hot laboratories and cells. Reference is made to the problems which the provision of leak-tightness raises with regard to building design and construction, and the solutions adopted are described. Finally, a discussion is given of the methods used for measuring and testing the degree of leak-tightness. (auth)

**19659** A QUANTITATIVE METHOD FOR THE SELECTION OF NUCLEAR POWER STATION SITES FROM THE SAFETY POINT OF VIEW. Carlos Vélez (Comisión Nacional de Energia Nuclear, Mexico City) and Vinicio Serment. IAEA Preprint No. SM-39/32. 14p. (In Spanish)

To be published in Proceedings of the IAEA Symposium on Criteria for Guidance in the Selection of Sites for the Construction of Reactors and Nuclear Research Centres, Bombay, India, 11-15 March, 1963.

The following procedure is suggested for siting nuclear power stations, materials testing reactors, and nuclear research centers of fairly large size. A relatively large number of sites should first be selected without reference to the safety aspect. In establishing a nuclear power station, for example, account should be taken of factors such as the distance from the consumption centers, the availability of cooling water, means of communication, etc. It should then be ascertained if each site selected would meet certain minimum safety requirements in the event of a serious accident. In the event of the maximum credible accident and in unfavorable atmospheric conditions, nobody outside the site, for example, should be exposed to a whole-body dose exceeding 25 rem. The reduction of the total dose to which the population would be exposed should determine the final selection of a site which meets the above requirements. In respect of each proposed site the average accident must be defined, taking into account all the conceivable accidents and their possible effects, together with the probability of occurrence in each case. For this purpose a large amount of information—some of which is difficult to obtain—is required on the intrinsic characteristics of the reactors involved, the distribution of population around the site, local meteorological and hydrological conditions, etc., and suitable models are needed in order to calculate the effects of a specific accident. Although the calculations required by this method involve a great deal of work, they can be done by digital computers. In the final selection of the site linear programming techniques can also be used with advantage. It is considered that the criterion of the total population dose may be useful in view of the rapid increase in the number of nuclear power stations throughout the world. It should be noted that no attempt has been made to furnish an economic evaluation of the damage to third parties which may result from an accident. (auth)

**19660** CRITERIA SET FOR THE SITE SELECTION FOR NUCLEAR POWER STATIONS. S. Andrzejewski (Inst. of Nuclear Research, Polish Academy of Sciences, Swierk). IAEA Preprint No. SM-39/10. 8p. (In English)

To be published in Proceedings of the IAEA Symposium on Criteria for Guidance in the Selection of Sites for the Construction of Reactors and Nuclear Research Centers, Bombay, India, 11-15 March, 1963.

Selection of the site for power reactors, i.e., for nuclear power stations, is influenced by the same factors as for the conventional power stations. These criteria are: (a) Siting in relation to the center of power consumption (problem of the transport of energy). (b) Transport costs of fuel. (c) Cooling water requirements. (d) Special criteria set by safety needs and suitability for construction of big and heavy buildings. At the present time and in the near future nuclear power stations will have the following features: (1) big units, (2) high utilization factor, (3) moderated steam conditions and thus requirements of great quantities of cooling water, and (4) potential hazard of contamination of the surrounding area. Big units and high utilization factor allow the transport of energy at low costs so the siting is less dependent on the distance of the energy transport. Cost of nuclear fuel transport is of minor importance. The most important criteria are set by safety needs and cooling water requirements. (auth)

**19661** DEVELOPMENT, GROWTH, AND STATE OF THE ATOMIC ENERGY INDUSTRY. PART 1. HEARINGS BEFORE THE JOINT COMMITTEE ON ATOMIC ENERGY, CONGRESS OF THE UNITED STATES, EIGHTY-EIGHTH CONGRESS, FIRST SESSION, FEBRUARY 20 AND 21, 1963. (United States Congress. Joint Committee on Atomic Energy). 1963. 479p. $1.25(GPO).

A compendium is presented of Congress hearings, reports, and other papers related to the atomic energy industry in the United States. The economics and future potential of nuclear power are discussed in relation to the total energy reserves of the nation. (D.L.C.)

**19662** SELECTION AND EVALUATION OF POSSIBLE SITES FOR A NUCLEAR POWER STATION TO FEED INTO THE MEXICAN CENTRAL GRID. Fuhed Sucar Sucar (Comisión Nacional de Energia Nuclear, Mexico City). IAEA Preprint No. SM-39/33. 13p. (In Spanish)

To be published in Proceedings of the IAEA Symposium on Criteria for Guidance in the Selection of Sites for the Construction of Reactors and Nuclear Research Centres, Bombay, India, 11-15 March, 1963.

Since it is desirable to study the possibility of using nuclear power in the case of thermal plants scheduled to be commissioned after 1968, consideration should be given, for reasons of economy, to large-capacity reactors whose application will therefore be limited to interconnected

electricity grids. The central grid will be the only one which will have an appreciable capacity at the end of the present decade and is therefore considered to be the most suitable for inclusion of a nuclear power plant. By analysing existing conditions and forecasts of future developments in the case of the Mexican central system, it is possible to determine the probable date of commissioning of a nuclear power plant, together with its capacity and general characteristics. Consideration of the general criteria to be applied in selecting suitable sites for nuclear power stations shows that, in the case of the Mexican central grid, the critical problem, relating to the generation of power, is the supply of cooling water. Thus the basic factor in selecting sites is the availability of water, and three possible sites have been selected near the consumption centers of the network. A preliminary analysis of these sites indicates that other requirements with regard to power generation and safety could be met. A technical and economic study of these sites is being carried out from the point of view of power supply, involving a comparative analysis of the possible alternatives for each site with a view of selecting the most suitable one in each case. It is noted that no site offers marked advantages, and a preliminary selection is made out of considerations of flexibility of operation of the high-voltage grid. It is therefore proposed that the final selection of the site for a nuclear power plant to be included in the Mexican central grid be based on a comparative analysis of the preliminary plans to be prepared for the plant and its auxiliary facilities in respect of each proposed site. (auth)

**19663** PROBLEMS IN NUCLEAR POWER REACTOR STABILITY. Henri B. Smets. Brussels, Presse Universitaire, 1962. 132p.

The equations for reactor dynamics at power level, which are intrinsically non-linear, are studied by various exact methods. New properties of stability, instability, and boundedness of the solution of the reactor dynamic equations are found without making a linear approximation. When the reactivity is a linear function of the power, a series of stability and instability properties are proved. A condition is derived under which the power of a reactor is unbounded when the reactivity becomes increasingly large. The describing function of nuclear reactors is introduced, and the conditions under which a locally unstable reactor has autonomous periodic oscillations are found. Practical results are shown and selected problems are solved by the methods introduced. (C.E.S.)

**19664** OPERATION OF A STEAM-POWER INSTALLATION WITH COMBINED HEATING USING NUCLEAR OR FOSSIL FUEL. Jiří Liška and Jiří Mikula. Czechoslovakia Patent 100,428. Aug. 15, 1961.

Three schematic arrangements of a steam-power installation are described and a method of operation is proposed using either nuclear or fossil fuel. Raising the heat content of the steam by energy from the nuclear reactor is accompanied by the utilization of heat of ordinary fuel, or fuel mixtures burned in the turbine. The steam-power installation circuits that are patented are noteworthy for the amount of equipment used, and its complexity; it consists of a nuclear reactor and cooling system, a two-stage axial compressor, a turbine, systems of coolers, condensers, regenerative feed water heaters, and generators. The operating principles of nuclear power units are described and are compared with steam, gas, and steam-air sets. (OTS)

**19665** SIMPLIFIED SODIUM GRAPHITE REACTOR SYSTEM. R. W. Dickinson (to U. S. Atomic Energy Commission). U. S. Patent 3,080,308. Mar. 5, 1963.

This patent relates to a nuclear power reactor comprising a reactor vessel, shielding means positioned at the top of said vessel, means sealing said reactor vessel to said shielding means, said vessel containing a quantity of sodium, a core tank, unclad graphite moderator disposed in said tank, means including a plurality of process tubes traversing said tank for isolating said graphite from said sodium, fuel elements positioned in said process tubes, said core tank being supported in spaced relation to the walls and bottom of said reactor vessel and below the level of said sodium, neutron shielding means positioned adjacent said core tank between said core tank and the walls of said vessel, said neutron shielding means defining an annular volume adjacent the inside wall of said reactor vessel, inlet plenum means below said core tank for providing a passage between said annular volume and said process tubes, heat exchanger means removably supported from the first-named shielding means and positioned in said annular volume, and means for circulating said sodium over said neutron shielding means down through said heat exchanger, across said inlet plenum and upward through said process tubes, said last-named means including electromagnetic pumps located outside said vessel and supported on said vessel wall between said heat exchanger means and said inlet plenum means. (AEC)

**19666** BOILING WATER REACTOR WITH FEED WATER INJECTION NOZZLES. Michael Treshow (to U. S. Atomic Energy Commission). U. S. Patent 3,087,881. Apr. 30, 1963.

This patent covers the use of injection nozzles for pumping water into the lower ends of reactor fuel tubes in which water is converted directly to steam. Pumping water through fuel tubes of this type of boiling water reactor increases its power. The injection nozzles decrease the size of pump needed, because the pump handles only the water going through the nozzles, additional water being sucked into the tubes by the nozzles independently of the pump from the exterior body of water in which the fuel tubes are immersed. The resulting movement of exterior water along the tubes holds down steam formation, and thus maintains the moderator effectiveness, of the exterior body of water. (AEC)

## Production Reactors

**19667** (JPRS-17876) THE STATE OF DEVELOPMENT OF FAST BREEDER REACTORS. D. Falkenberg. Translated from Kernenergie, 5: 701-34(Oct.-Nov. 1962). 61p. (OTS-63-21232)

The significance of breeding reactors is discussed, including the utilization of nuclear fuel in thermal reactors and methods of breeding. The goals of present development goals are listed and the present state of development evaluated. The development of fast breeders in the United States, Soviet Union, Great Britain, and France is described. A comparative tabulation of the characteristic data and parameters of 9 fast breeders is presented, along with an evaluation of the data. (M.C.G.)

## Research Reactors

*Refer also to abstract 17644.*

**19668** (IDO-16819) AN ANALYSIS OF NONBOILING REACTIVITY FEEDBACK MECHANISMS IN PRESSURIZED POWER EXCURSIONS IN THE SPERT III REACTOR. Richard W. Garner (Phillips Petroleum Co. Atomic En-

ergy Div., Idaho Falls, Idaho). Jan. 18, 1963. Contract AT(10-1)-205. 108p.

For plate-type, water-moderated and -cooled nuclear reactors, the physical mechanisms responsible for the observed self-limiting behavior of the reactor system to large reactivity perturbations include: expansion of the fuel plates, decrease in density of the water due to an increase in the water temperature, and boiling of the water moderator-coolant adjacent to the fuel plate surfaces. Calculations were carried out to determine the extent to which the processes of fuel plate expansion and moderator expansion contribute to the observed self-limiting behavior of the Spert III reactor, for power excursions at initial pressures sufficiently high that boiling of the moderator does not occur prior to the peak of the power burst. In spite of the fact that the reactivity compensating effects of fuel plate expansion and moderator expansion were slightly overestimated, the results indicated that the combined effects of these two mechanisms are insufficient to account for the observed self-shutdown behavior of the Spert III reactor in the absence of boiling. (auth)

**19669** (JAERI-1043) ON THE TEMPERATURE RISE OF THE JRR-3 FUEL ELEMENT BY DECAY HEAT. Konomo Sanokawa and Mitsuo Ouchi (Japan Atomic Energy Research Inst., Tokyo). 1963. 35p. (In Japanese)

In cases of an emergency such as the leakage of heavy water coolant and the failure of electric power supply, the fuel elements may be left in the reactor vessel without any coolant, in the air at room temperature, in the cask or under some other conditions. The decay heat will cause the temperature of the fuel elements to rise. The temperature rise in the fuel elements in such cases was calculated. The reliability of the calculated results was checked by measuring the heat transfer rate of the JRR-3 mock-up fuel element cooled by either natural or forced convections in steady state. (auth)

**19670** (JAERI-1045) 2nd POWER-UP TEST FOR JRR-2. (Japan Atomic Energy Research Inst., Tokyo). 1963. 13p. (In Japanese)

The 2nd startup for JRR-2 (Japan Research Reactor No. 2) was begun Nov. 15, 1961. The reactor attained 3 Mw on Nov. 29, operating for a 24 hr continuous operation in good condition. (auth)

**19671** (JÜL-70-RE) REAKTIVITATSMESSUNGEN BEIM FRJ-1 MERLIN. (Reactivity Measurements with the FRJ-1 Merlin). H. Kraemer, W. Porschen, and P. A. Solari (Kernforschungsanlage, Jülich, Germany). Aug. 1962. 45p.

Using pulsed source measurements, doubling time and rod fall measurements during the first approach phase of the FRJ-1 (MERLIN) in February and March 1962, the operation of the two safety rods and the control rods in 8 different nuclear configurations with a maximum of 24 fuel elements was tested. For the $4 \times 5$ and $4 \times 6$ cores, in addition, the differential reactivity curves of the control rods were measured. Further the reactivity yields in the increase of the reactor core from $4 \times 4$ to $4 \times 6$ fuel elements were measured with pulsed sources. From that the excess reactivity of the $4 \times 5$ core was calculated to be 4.12% $\Delta k/k$ and that of the $4 \times 6$ core to be 6.8% $\Delta k/k$. The reactivity worth of the control rods and safety rod A varied according to the size of the core configuration between 3.04 and 5% $\Delta k/k$, that of safety rod B between 3.16 and 4.22% $\Delta k/k$. Together the control rods absorbed 8.4 to 15.8% $\Delta k/k$. (tr-auth)

**19672** (LADC-5631) MATHEMATICAL AND EXPERIMENTAL ANALYSIS OF TEMPERATURE DISTRIBUTIONS IN STORED IRRADIATED LAMPRE CAPSULES—AN ITERATIVE EQUATION GENERATION PROCEDURE. John C. Biery and Robert N. Kennedy (Los Alamos Scientific Lab., N. Mex.). [1961]. Contract [W-7405-eng-36]. 46p.

Temperature profiles in stored irradiated LAMPRE (Los Alamos Molten Plutonium Reactor Experiment) fuel capsules were simulated both mathematically and experimentally. Each capsule which contains 90 at. % Pu and 10 at. % Fe fuel could produce up to 200 watts of fission product heat power after long term exposure in the reactor and could develop temperatures in storage that would accelerate the corrosion of the tantalum capsules. The experimental and mathematical simulations were made to investigate the temperature problems that could arise on storage of the capsules. The mathematical analysis produced solution equations from the four coupled second-order differential equations by an iterative generation procedure. The generated equations were then used in an iterative computer program which produced the convergent temperature profiles by a calculation and correction technique. The iteratively generated equations, coupled with the computer program, produced temperatures which agreed very satisfactorily with the experimental simulation results. Because of this agreement, the iterative equation generation procedure can be recommended for similar complex longitudinal-radial heat transfer problems. (auth)

**19673** (NAA-SR-3220) ORGANIC MODERATED REACTOR CRITICAL EXPERIMENT HAZARDS SUMMARY. G. B. Zwetzig (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Dec. 15, 1958. Contract AT(11-1)-Gen-8. 169p.

A series of experiments was planned utilizing a critical assembly mock-up with slightly enriched fuel in a heterogeneous, organic-moderated lattice. The fuel elements are uranium metal fabricated into flat plate, box-type fuel elements and other elements of special design. The moderator and reflector are Santowax-R. The critical assembly vessel is designed of mild steel, about 6 ft in diameter and $8\frac{1}{2}$ ft high. The moderator is maintained in a liquid state by means of electrical heating. The temperature range for the experiments is 325 to 600°F in an unpressurized system. Boron carbide-filled shim and safety rods, actuated by cables, are used for control. The laboratory consists of a concrete-shielded high-bay critical assembly cell, an adjoining control room, and supporting facilities. The laboratory design includes provisions for filtering the critical assembly room effluent air as required, and for hold-up of any liquid radioactive waste generated. Various operating and equipment failures are postulated and analyzed, including the case of complete safety system failure. It was concluded that the maximum credible accident could not constitute a significant hazard to the public. (auth)

**19674** (NAA-SR-7925) SRE THIRD CORE HEAT TRANSFER ANALYSIS. Interim Report. J. S. McDonald (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Apr. 1, 1963. Contract AT(11-1)-Gen-8. 66p.

A preliminary analysis was made of the steady-state heat transfer characteristics of the Sodium Reactor Experiment (SRE) with a UC fuel loading. It was found that the maximum temperature objective for the fuel, 2050°F, could be achieved within the maximum reactor power of 30 Mwt through the use of a 19-element loading. Each fuel cluster would have 9 rods of 5-ft length, and the fuel pins would be of 0.5-in. dia. A statistical analysis of fuel temperature

uncertainty indicated little likelihood that the fuel temperature objectives would not be met with this arrangement. Studies of the graphite moderator indicated that a nominal spacing of 0.165 in. between cans should allow adequate cooling. The maximum estimated horizontal temperature variation across the flats was ~90°F. The peak poison column ($B^{10}$–Ni) heating rate was calculated by four different methods for the case of control rods fully penetrating the core. The results were found to be in good agreement, and the heating rate for this condition is not expected to exceed 12 kw/ft. On this basis it appears that a dry control rod concept should be satisfactory; however, final selection of concept must await the analyses of conditions with control elements partially inserted in the core. (auth)

**19675** (NAA-SR-Memo-7953) RADIATION EMBRITTLEMENT OF OMRE GRID PLATES. J. F. Marron (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). June 30, 1962. Contract [AT(11-1)-Gen-8]. 23p.

The effects of radiation on the grid plates of the OMRE reactor vessel were evaluated. Results indicate that severe irradiation embrittlement has already occurred. Currently the nil brittle temperature, ultimate strain, and yield strength are estimated to be 325°F, 17%, and 62,000 psi, respectively. Charts are included showing these material properties and the corresponding recommended pressure loads as functions of the operating temperature and megawatt days of power. Exceeding these recommended pressures while the grid plates are in the brittle temperature zone should not of itself cause failure. However, any concurrent mechanical or thermal shock could cause a ligament to fracture. Recommendations for safe operation are included. (auth)

**19676** (NAA-SR-Memo-7982) TEMPERATURE PROFILES AS A FUNCTION OF CONTROL ROD POSITION (RTP 62-T-095). J. O. Zane and J. Kajor (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Nov. 16, 1962. Contract [AT(11-1)-Gen-8]. 13p.

Anomalous behavior of in-core fuel element temperatures in the OMRE was recently observed. Specifically, thermocouple number 356 on the APM–$UO_2$ test element 4–3 indicated temperatures consistent with those at the reactor midplane, but is supposedly located 12 in. below the midplane. Since experience has shown that fuel element temperatures are strongly affected by the position of adjacent control rods, a test was performed to verify the location of thermocouple 356. The results indicate that this thermocouple has an effective junction at 2 in. below the reactor midplane. (auth)

**19677** (ORNL-3288) IN-AIR MEASUREMENTS IN THE VICINITY OF THE TOWER SHIELDING REACTOR II. F. J. Muckenthaler, L. B. Holland, and R. E. Maerker (Oak Ridge National Lab., Tenn.). Apr. 8, 1963. Contract W-7405-eng-26. 75p.

During the course of an extensive test program at the Tower Shielding Facility, a large number of measurements were made of the thermal-neutron fluxes and fast-neutron and γ dose rates in air due to radiation emitted by the TSR-II. These "free-field" measurements, so called due to a minimum of structural interferences, were performed for reactor-detector separation distances of 1100 ft, reactor heights of 175 ft, and detector heights of 145 ft. The reactor was encased in two different shields, COOL-I and COOL-II, which were designed to give a fast-neutron to γ physical dose-rate ratio of 1.5 at large distances from the reactor and a thermal-neutron flux leakage that would cause ~30% of the γ dose rates in the field to be due to neutron captures by nitrogen. The significant difference between the two shields was in the hardness of the γ and fast neutron leakage spectra. A summation of the data obtained and a description of the conditions under which the measurements were made are presented. (auth)

**19678** SOLUTION-TYPE RESEARCH REACTOR HAS UNIQUE FEATURES. Atomics, 16: No. 2, 15-16(Mar.-Apr. 1963).

The 50,000-watt research reactor at the Walter Reed Army Institute of Research is described. The core consists of a spherical stainless steel tank containing four control rod thimbles which project vertically into the tank and a horizontal central exposure tube giving access to the core interior for experimental purposes. Stainless steel cooling coils are coiled within the core. The core assembly contains the fuel and moderator in the form of uranyl sulfate dissolved in ordinary water. A vertical overflow tank at the top of the core provides space for any fuel solution that may be forced out of the core in the event of a power surge. (M.C.G.)

**19679** THE OUTPUT SPECTRUM OF FAST COLLIMATED NEUTRONS FROM THE ROSSENDORF RESEARCH REACTOR AND ITS MODIFICATION THROUGH WATER LAYERS. G. Ruickoldt (Zentralinstitut fllr Kernphysik, Bereich Reaktortechnik und Neutronenphysik, Rossendorf, Ger.). Kernenergie, 5: 831-9(Dec. 1962). (In German)

The output spectrum of fast collimated neutrons from a horizontal channel of the Rossendorf research reactor and its modification by passage through water layers was investigated using nuclear trace plates. The fast flux is $\Phi = (3.6 \pm 0.5) \times 10^5$ neutrons/cm$^2$/sec/W/sterad, with a relaxation length of 5.3 cm. The spectrum was explained. The spectra measured from the water layer show that the fast neutrons under the conditions given are exclusively "direct neutrons"; no fraction of scattered neutrons is detectable. It is therefore possible to calculate the spectral distribution for other horizontal channels of this reactor type. (tr-auth)

**19680** CONTROL EQUIPMENT FOR THE REACTOR MELUSINE II. M. Cordelle, V. Delcroix, P. Denis, and R. Gariod (Centre d'Études Nucléaires, Grenoble, France). Onde Elec., No. 427, 11p. (Oct. 1962). (CEA-2246). (In French)

Melusine II, a low-power reactor designed to study the SILOE core, diverged at the Centre d'Études Nucléaires in Grenoble, on May 23, 1962. The control panel designed and developed in this Center is the first to be completely transistorized in France. The first months of operation justified the hope put into the electronic devices to improve stability and dependability. The monitoring design is described. The main characteristics of the measuring circuitries and actions on reactivity are given. (auth)

**19681** THE POSSIBILITY OF USING THE AGN-201 REACTOR "CONSTANZA" WITH PARTICULAR REFERENCE TO THE PRODUCTION OF SHORT-LIVED ISOTOPES. Elio Oliveri (Università, Palermo, Italy). Radiol. Prat., 11: 167-74(Mar.-Apr. 1961). (In Italian)

The AGN-201 reactor "Constanza" in Palermo went critical February 12, 1960. A brief description is given of the reactor. The irradiation facilities and the activity levels are illustrated with a consideration of some limitations. An indication is given of the production of carrier-free isotopes. (tr-auth)

**19682** DEDICATION OF THE FIRST ATOMIC REACTOR IN FINLAND. E. Tommila. Suomen Kemistilehti, 35A: 170-3(1962). (In Finnish)

A TRIGA Mark II reactor, designated as "FiR 1" and designed by the General Atomics Corp. was dedicated on March 31, 1962, at Otaniemi (Finland). The reactor went critical for the first time on March 27, 1962, at 4:10 p.m. The effective power of the reactor is 100 kw(t); it uses 2.28 kg of 20% enriched $U^{235}$ as fuel and has an average core flux level of about $1.6 \cdot 10^{12}$ n/cm$^2$ sec. The Institute of Technology of Helsinki operates the reactor on behalf of the Finnish Government. Five other TRIGA reactors are at present in operation or under construction in Europe, – at Rome, Vienna, Geneva, Mainz, and Otaniemi. The small subcritical assembly at Otaniemi will continue to be used for teaching and training purposes. (TTT)

**19683** A SITING STUDY FOR A NUCLEAR RESEARCH CENTRE IN MEXICO. R. Treviño (Comisión Nacional de Energia Nuclear, Mexico City), L. Gálvez, E. Jáuregui, M. Mazari, V. Serment, and C. Vélez. IAEA Preprint No. SM-39/31. 22p. (In Spanish)

To be published in Proceedings of the IAEA Symposium on Criteria for Guidance in the Selection of Sites for the Construction of Reactors and Nuclear Research Centres, Bombay, India, 11-15 March, 1963.

Results are presented of a siting study for a nuclear research center to be built near Mexico City. The study concentrated on six points around Mexico City, since the most important universities, technical institutes, and research centers in the country are located there. The six sites considered were classified according to their meteorological, seismological, and hydrological characteristics and soil mechanics. A population study was also carried out within a radius of up to 30 kilometers from each location in question. Criteria are given which are to be applied to the classification mentioned for the purpose of selecting the most suitable site. (auth)

**19684** USING THE NEUTRON FLUX FROM THE THERMAL COLUMN OF THE WWR-C REACTOR AS A CALIBRATION FLUX. S. Pszona and K. Zarnowiecki (Inst. of Nuclear Research, Warsaw). IAEA Preprint SM-36/111. 10p. (In Russian)

To be published in Proceedings of the IAEA Symposium on Neutron Detection, Dosimetry and Standardization, Harwell, United Kingdom, December 10-14, 1962.

Use of the slow neutron flux at the outlet of the vertical channel of the reactor's thermal column as a calibrating flux is proposed. This flux offers various advantages. The results are given of investigating changes in time in the neutron flux and the accuracy of the flux values determined. The slow neutron flux from the vertical channel of the thermal column of the WWR-C reactor is used in the Swierk Nuclear Research Centre (Poland) for calibrating dosimetric measuring equipment. The accuracy of calibration so obtained is perfectly adequate for requirements. (auth)

# SPACE APPLICATIONS AND TECHNOLOGY

**19685** (AEDC-TDR-62-152) ANALYTICAL AND EXPERIMENTAL STUDIES TO DEVELOP ION ENGINE GROUND-TESTING TECHNIQUES. R. A. Hubach and G. B. Peppin (Hughes Research Labs. Div. of Hughes Aircraft Co., Malibu, Calif.). Sept. 1962. Contract AF40(600)-948. 28p. (AD-284272)

A technical review concerning the analytical and experimental aspects of ground simulation of space conditions for ion engine testing is presented. The conditions assumed to be best for simulation are presented and plans for experimental studies are detailed. Two new probes for beam diagnostics are discussed together with a new technique for studies of beam interactions with the test chamber environment. Data obtained using the probes and techniques are included where possible. A brief discussion of possible space phenomena effects on ion engine operation is included with estimates of the magnitude of the effects on engine behavior. Theoretical computer studies of the behavior of the ion beam as it leaves the engine are outlined, and the results expected from such a program are discussed. (auth)

**19686** (CAL-VG-1403-G-5) OUTER-SPACE ENVIRONMENT MODELS FOR USE WITH SPACE VEHICLE SIMULATORS. [Period Covered], November 14, 1960–November 14, 1961. William A. Livingston, Jr. (Cornell Aeronautical Lab., Inc., Buffalo). May 1962. Contract AF33(616)-6858. 69p. (AD-283284; MRL-TDR-6240)

A summary of the important aspects of the environment in cislunar space important to the simulation of space vehicles is presented. Models of this environment are developed, and estimates of the required parameters are made on the basis of currently available data. These models were constructed with an emphasis toward maximum simplicity of representation, in order that the computations be compatible with real time simulation of space vehicles. (auth)

**19687** (NAA-SR-7797) SNAP AEROSPACE SAFETY PROGRAM QUARTERLY TECHNICAL PROGRESS REPORT, JULY–SEPTEMBER 1962. (Atomics International. Div. of North American Aviation. Inc., Canoga Park, Calif.). Mar. 20, 1963. Contract AT(11-1)-Gen-8. 56p.

Statements are presented concerning project objectives, major accomplishments in FY 1962, progress during the report period, evaluation of effort to date, and next report period activities. The subject material covers reactor separation and fuel element ejection, reactor transient and excursion tests, reactor end-of-life shutdown devices, fission product release studies, critical configuration tests, mechanical and thermochemical effects, and fuel element burnup and fission products dispersal. Major emphasis for the period was concentrated on the design of the SNAPTRAN 2/10A-1 and -2 machines and the models for the Reentry Flight Demonstration (RFD-1). Planning of the SNAPTRAN experimental program was undertaken. Analytical effort was concentrated on developing the several computer codes required for interpreting and understanding the data acquired or to be acquired from the experiments. The majority of the Phase I mechanical and thermochemical effects test program was completed. A few fission product releases were conducted at the NRTS. Necessary test apparatus for the water immersion critical experiment was designed and fabricated. (auth)

**19688** (NAA-SR-8097) SNAP AEROSPACE SAFETY PROGRAM. Quarterly Technical Progress Report, October–December 1962. (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Apr. 1, 1963. Contract AT(11-1)-Gen-8. 40p.

Progress made during the period is reported including analyses of experiments and tests, and evaluation of effort. The subject material concerns reactor transient and excursion tests, fission product release studies, end-of-life shutdown devices, critical configuration studies, mechanical and thermochemical effects, reactor separation and fuel element ejection, and reentry burnup of fuel elements. The design of the SNAPTRAN 2/10A-1 and -2 machines was essentially completed and fabrication of major components was initiated. The fission product release tests at the NRTS were completed. Some progress was made on the explosive shutdown projectile design. A practical shipping sleeve design was demonstrated which will maintain the SNAP 2/10A assembly in a subcritical condition as a result of postulated shipping accidents. The Phase I ground test series were completed. The computer code, RESTORE, was shown to be excellent for the calculation of reentry trajectories. The calculation of fuel rod heating and ablation using a digital thermal analyzer program resulted in an improved and more elaborate analytical model. (auth)

**19689** (TID-15222) HIGH ACCELERATION FIELD HEAT TRANSFER FOR AUXILIARY SPACE NUCLEAR POWER SYSTEMS. Quarterly Technical Report, September 1 through November 30, 1961. H. F. Poppendiek, N. D. Greene, and H. G. Hughes (Geoscience Ltd., Solana Beach, Calif.). Contract AT(04-3)-409. 31p. (GLR-6)

Research results on liquid metal heat and momentum transfer are presented. A review and summary are presented of previously obtained data on liquid metal non-boiling and boiling heat transfer and non-boiling momentum transfer. A convective heat transfer solution is described which can be used to predict heat transfer in liquid metals flowing turbulently in channels and longitudinally past fuel rods in reactor cores prior to the initiation of boiling. Several mathematical two-phase flow models are analyzed and the solutions evaluated; the results can be used to estimate pressure drop in boiling liquid metal flow systems under zero and artificial radial gravity conditions. A design for an experimental, flow visualization system for the purpose of studying two-phase flow phenomena under centrifugal fields is presented. The preliminary design of an Hg heat transfer system in which boiling and condensation mechanisms are to be studied is also reviewed. (auth)

**19690** (TID-15223) HIGH ACCELERATION FIELD HEAT TRANSFER FOR AUXILIARY SPACE NUCLEAR POWER SYSTEMS. [1961]. Quarterly Technical Report, December 1 through February 28, 1962. H. F. Poppendiek, N. D. Greene, H. G. Hughes, and C. M. Sabin (Geoscience Ltd., Solana Beach, Calif.). Contract AT(04-3)-409. 49p. (GLR-8)

Research results on liquid metal heat and momentum transfer are presented. A review and summary of boiling heat transfer models found in the literature are presented; nucleate pool and film boiling models are examined, and a comparison of the various models is made. Several boiling heat transfer analyses are outlined. One analysis considers free convection film boiling from a vertical plate and the other describes forced convection film boiling in a

pipe. Additional two-phase flow analyses conducted include turbulent-viscous pipe flow, turbulent-turbulent pipe flow, and viscous-viscous curvilinear channel flow. A number of preliminary two-phase, curvilinear flow experiments were completed in pipes containing helical guides. Information on flow patterns and phase separation was obtained using air and water. The results of studies on the Mollier Diagrams and physical properties of Hg and K are also included. (auth)

**19691** (TID-16052) HIGH ACCELERATION FIELD HEAT TRANSFER FOR AUXILIARY SPACE NUCLEAR POWER SYSTEMS. Quarterly Technical Report, March 1 through May 31, 1962. H. F. Poppendiek, N. D. Greene, H. R. Wright, and A. S. Thompson (Geoscience Ltd., Solana Beach, Calif.). Contract AT(04-3)-409. 27p. (GLR-9)

Research results on liquid metal heat and momentum transfer are presented. A summary of the experimental single- and two-phase (water and air) pressure drop measurements in a single fluted helix is presented; photographic descriptions of the geometrical characteristics of the two-phase flow are also given. The experimental pressure drop results are compared with Martinelli's correlation and the viscous-turbulent separated, two-phase flow pressure drop solution presented in the previous quarterly report. Analytical studies are outlined for the velocity decay of thin laminar and turbulent liquid layers in vortex motion in a circular pipe. The predictions for single-phase flow are compared with experimental decay measurements. Velocity decay solutions for the case where gaseous films exist between the thin rotating liquid layers and the stationary wall are also described. A description is given of the characteristics of the Hg heat transfer system whose components are being procured. Equations were derived for void coefficients of reactivity in bare, homogeneous, uniform reactors cooled by boiling liquid metals. It is shown that for a boiling coolant having a fixed ratio of absorption-to-scattering cross section, there is a size of reactor above which the void coefficient is positive and below which it is negative. (auth)

**19692** ELECTRICAL PROPULSION CAPABILITIES FOR LUNAR EXPLORATION. Harold Brown and Harry E. Nicoll, Jr. (General Electric Co., Evendale, Ohio). AIAA (Am. Inst. Aeron. Astronaut.) J., 1: 314-19(Feb. 1963).

The logical result of a successful Apollo program can be expected to be a large scale operation involving manned lunar exploration and colonization. The potential role of electrical propulsion in such an operation is examined. Primary emphasis is placed on the identification of mission capabilities for providing logistic support. Electrical engine and nuclear-mechanical power conversion system experience is projected to the 1 to 10 Mw range and used to identify expected system characteristics. Both thermal arc and ion engines are considered. A basic mission profile is defined, and typical trajectory characteristics are discussed. The low thrust characteristic velocity requirement for the basic mission is identified and used to generate parametric mission performance characteristics for one-way, round-trip, and multitrip missions. These data indicate the interrelations between gross weight, power rating, specific impulse, and total propulsion time and their effect on payload capabilities. The resulting data then are compared with the capabilities of comparable chemical and nuclear rocket-propelled vehicles. (auth)

**19693** CAPTURING THE ASTEROID. Dandridge M. Cole. Astronaut. Aerospace Eng., 1: 88-93(Mar. 1963).

The capture of an asteroid is considered as a possibility within the next decade, especially with the advent of nuclear spacecraft. Data concerning the close-approach asteroids are given. Requirements for nuclear and chemical vehicles are compared as well as direct operating costs. The nuclear energy required to capture an asteroid and change its orbit from a heliocentric ellipse to a geocentric ellipse is computed. Thirty-nine references are cited. (C.E.S.)

**19694** SPACE DEMANDS NUCLEAR POWER SYSTEMS. B. C. Lindley (C. A. Parsons and Co. Ltd., Newcastle upon Tyne, Eng.). Engineering 194: 457-8(Oct. 5, 1962).

Power requirements for space vehicles are discussed. Reactor heat sources, energy converters, and integrated systems are described. (M.C.G.)

**19695** BUSINESS OPPORTUNITIES IN THE NUCLEAR SPACE PROGRAM. Proceedings of the Seminar, November 29, 1962, Washington, D. C. New York, Atomic Industrial Forum, Inc., [1963]. 81p. $3.00

Eleven papers and two question-and-answer sessions are presented on the problems of marketing in the nuclear space business. Some of the topics discussed are technology, nuclear rockets, SNAP systems, and contracting procedures and opportunities. (D.L.C.)

**19696** RADIATION SHIELDING OF LUNAR SPACECRAFT. T. G. Barnes, E. M. Finkelman, and A. L. Barazotti. p.52-71 of "Lunar Exploration and Spacecraft Systems." R. Fleisig, ed. New York, Plenum Press, 1962.

A description of the radiation environment to be encountered in space is presented. A model of the spatial, spectral, and temporal variation of charged particles from the Van Allen belts and cosmic radiation is established. Calculations were performed to determine the relative effectiveness of varying thicknesses of different shielding materials as a function of geometry of the shield. Tissue dose rate variation with time for a typical three-dimensional lunar trajectory is presented and compared to flight radially in the plane of the magnetic equator. The total integrated biological dose as a function of carbon shield thickness was calculated for four solar flare events and for flight radially out through the inner belt. It is shown that approximately 10 g/cm$^2$ of carbon shielding is sufficient to shield not only the inner-belt protons, but would also provide adequate protection against solar flares of the magnitude that occurred in March and August of 1958. It was found to be impossible to shield against solar flares of the highest known energy within the reasonable weight limits of a typical lunar mission. (Aerospace Med., 33: Dec. 1962)

# WASTE DISPOSAL AND PROCESSING

*Refer also to abstract 19602.*

**19697** (DP-713) CALCINATION OF RADIOACTIVE WASTE IN MOLTEN SULFUR. Milton W. Davis, Jr., Edward S. Occhipinti, and Claude B. Goodlett (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). Mar. 1962. Contract AT(07-2)-1. 23p.

A method was developed for converting radioactive wastes from the processing of irradiated fuel elements to a relatively insoluble form that could be stored in suitable rugged containers. The aqueous wastes are fed into a vessel containing molten (150°C) sulfur so that the water and volatile acids are driven off and the chemical compounds present are both decomposed and reduced. Wastes containing both stainless steel nitrates and aluminum nitrates were treated in this manner. The physical behavior in water of solid samples of the resulting slurries were satisfactory when the initial calcination at 150° is followed by a second heating step at 400 to 444°C. Leaching rates were low for both mixed fission products and plutonium. (auth)

**19698** (HW-65838 RD) FLUIDIZED-BED CALCINATION STUDIES WITH SIMULATED ICPP WASTE SOLUTION. K. J. Schneider (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). June 6, 1960. Contract AT(45-1)-1350. 19p.

A fluid-bed calciner pilot plant was built to study the problems involved in calcined simulated waste solutions (primarily Purex 1WW). Data obtained during three months operation to provide experience and to permit evaluation of the calciner feed solution using simulated ICPP feed are presented. Studies with Purex-type waste feeds are in progress. (J.R.D.)

**19699** (HW-66384RD) FLUIDIZED BED CALCINATION OF SIMULATED PUREX HIGH-ACTIVITY LEVEL WASTES. Interim Report. M. D. Alford (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Sept. 1, 1960. Contract AT(45-1)-1350. 28p.

A summary of experimental progress on fluid bed calcination studies of Purex-type wastes being conducted at Hanford is presented. The information is preliminary and final interpretation of these and other data will be reported when the studies have progressed far enough. (J.R.D.)

**19700** (HW-SA-2722) RADIANT-HEAT SPRAY-CALCINATION PROCESS FOR THE SOLIDIFICATION OF RADIOACTIVE WASTE. Rudolph T. Allemann and Benjamin M. Johnson (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Aug. 16, 1962. Contract AT(45-1)-1350. 25p.

The application of the radiant-heat spray calciner to the continuous calcination of simulated radioactive waste was studied. The experimental equipment is described, and the effect of various operative variables on factors such as capacity and completeness of calcination are discussed. (auth)

**19701** (HW-SA-2877) HOT-CELL STUDIES ON THE SOLIDIFICATION OF HANFORD HIGH-LEVEL WASTES BY RADIANT-HEAT SPRAY AND POT CALCINATION. R. T. Allemann, R. L. Moore, F. P. Roberts, and U. L. Upson (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Jan. 1963. Contract AT(45-1)-1350. 42p.

Hot-cell calciner equipment for use as a spray or pot system is described. Preliminary results of radioactive waste fixation in a solid medium using full-level Hanford Purex Plant waste are included. (J.R.D.)

**19702** (HW-SA-2958) CONCENTRATION OF LIQUID RADIOACTIVE WASTES BY DIRECT CONTACT HEAT TRANSFER. Sidney R. Bierman (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). 1962. Contract AT(45-1)-1350. 64p.

Thesis submitted to Univ. of Washington, Seattle.

The process design of a prototype facility for carrying out a test program on solidifying liquid radioactive wastes is presented. The test program is divided into two phases. During the initial phase of the test program approximately two million gallons of non-boiling wastes, that is low heat generating wastes, from the Purex process are to be processed through the prototype facility for determining the effect of different operating variables on the behavior of the in-tank wastes, particulate entrainment in the evolved vapor, the rate of concentration, and the waste concentration factor. Upon completion of the first phase of the test program, the prototype facility is to be installed in an adjacent waste storage tank to check out the portability of the facility and to determine the feasibility for concentration of a blended waste containing various amounts of heat generating fission products. In addition to the storage benefits gained by concentrating these wastes, information obtained from operating the prototype facility is to be used for designing production scale units capable of concentrating other stored and currently accumulating wastes. (auth)

**19703** (TID-7644) THE USE OF INORGANIC EXCHANGE MATERIALS FOR RADIOACTIVE WASTE TREATMENT. A Working Meeting held at Washington, D. C., August 13-14, 1962. D. K. Jamison, B. H. Kornegay, W. A. Vaughan, and J. M. Morgan, Jr., eds. (Johns Hopkins Univ., Baltimore). Jan. 1963. Contract AT(30-1)-1477. 238p.

A total of eleven papers and one section containing comments on future plans are presented in the meeting summary report. Separate abstracts were prepared for ten of the papers. The paper for which no abstract was prepared concerned properties of hydrogen-based clinoptilolite. (J.R.D.)

**19704** (TID-7644(p.13-28)) MINERAL EXCHANGE AT THE UNIVERSITY OF NORTH CAROLINA. Henry C. Thomas (North Carolina. Univ., Chapel Hill).

The thermodynamics of ion-clay interactions in small chromatographic columns are reviewed. Tracer techniques were used in montmorillonite uptake experiments on ion pairs such as Na–Cs, Cs–Ba, and Na–Ba. Other work is reported on clinoptilolite ion exchange under equilibrium conditions with special attention directed toward hydrogen ion behavior. Simpler cases involving interaction of complex solutions and the mineral sorbents in the soil were studied. (J.R.D.)

**19705** (TID-7644(p.29-45)) MINERAL EXCHANGE WORK AT OAK RIDGE NATIONAL LABORATORY. T. Tamura (Oak Ridge National Lab., Tenn.).

Experimental findings on vermiculite and biotite ion exchange reactions are discussed. Also the effects of commercial grundite for Cs removal from waste are reported. Data and other information are also included on Sr

removal from wastes by various clays and other ion exchange materials such as hydrous Al and Fe minerals and Conasauga shale. (J.R.D.)

**19706** (TID-7644(p.75-82)) MINERAL EXCHANGE IN CANADA'S WASTE TREATMENT PROGRAM. L. C. Watson (Atomic Energy of Canada Ltd., Chalk River, Ont.).

A brief review of waste disposal to ground at Chalk River is presented. Results of work using clinoptilolite and plans for use of this material on low-level waste streams are also included. Work in mineral preparation, waste liquor clarification, and process chemistry is emphasized. (J.R.D.)

**19707** (TID-7644(p.83-114)) HANFORD MINERAL EXCHANGE PROGRAM. J. L. Nelson (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Waste processing by use of clinoptilolite and snythetic exchange materials is reviewed. Data and discussion are included on Cs removal from formaldehyde-treated waste (FTW) and flowsheets for Cs packaging for disposal. Data are also included on the effects of flow rate, temperature, and concentration on Cs breakthrough in clinoptilolite exchange. Information is also included on breakthrough of various ions on clinoptilolite, concentration of fission product tracers in FTW feed and waste, elution of $Cs^{137}$ from clinoptilolite, and elution of Sr and Cs after heating of loaded exchangers. (J.R.D.)

**19708** (TID-7644(p.115-50)) MINERAL REACTION WORK AT HANFORD. Lloyd L. Ames, Jr. (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Equilibrium and kinetic studies of radioisotope-removing mineral reactions are reported. The reactions being studied include replacement types such as gypsum-Ba cation materials and calcite $-PO_4$ and $-F^-$ anion materials. Ion exchange types such as zeolite and clinoptilolite are also being studied. Considerable data are included and discussed concerning various parameters of equilibrium conditions and exchange column capacities. (J.R.D.)

**19709** (TID-7644(p.151-75)) MINERAL REACTION STUDIES AT NATIONAL REACTOR TESTING STATION. Daniel B. Hawkins (Idaho Operations Office, AEC).

An outline of the NRTS program for waste processing by mineral reactions is presented. Work is in progress on a reconnaissance study concerning the decontaminating properties of ion exchange materials such as lignite, bentonite, rock phosphate, montmorillonite-enriched sediments, and clinoptilolite-bearing vitric tuff. Disposal of small-volume wastes in cribs in one or more of these materials is being considered. Other work is reported on the capacity of alluvial sediments which underlie the basalt at NRTS to decontaminate low-level liquid wastes. (J.R.D.)

**19710** (TID-7644(p.177-86)) ACCUMULATION AND MOVEMENT OF FISSION PRODUCTS IN SOILS AND PLANTS. R. G. Menzel (Department of Agriculture, Beltsville, Md.).

The effects of temperature on the fixation of $Sr^{90}$ in various soil types were investigated. Four soil types were selected on the basis of known ability to fix Sr and suspected dominance of various mechanisms. For example, Davidson and Dunbar soil types probably fix by absorption and diffusion into amorphous material. Maury soil may fix by precipitation or recrystallization of phosphates. Huntley, a calcareous soil, may fix by precipitation or recrystallization of carbonates. Fixed $Sr^{85}$ was determined at various time intervals after incubating the soil samples at various temperatures with various amounts of Sr carrier. An analysis of experimental results is included. (J.R.D.)

**19711** (TID-7644(p.187-99)) MINERAL EXCHANGE WORK AT OAK RIDGE NATIONAL LABORATORY. D. G. Jacobs (Oak Ridge National Lab., Tenn.).

Work on exchange parameters of deep-well disposal of low- and intermediate-level radioactive wastes is reported. Data are included on Ca–Sr exchange by sand–calcium carbonate mixtures and Cs sorption from NaCl solutions. (J.R.D.)

**19712** (TID-7644(p.201-10)) DEVELOPMENT OF AN EFFECTIVE ALUMINO–SILICATE ADSORBENT FOR RADIOACTIVE WASTE DISPOSAL. W. L. Haden, Jr. (Minerals and Chemicals Philipp Corp., Menlo Park, N. J.).

Research and development programs on synthesis of clinoptilolite, sodium aluminum silicates, pelletization of clinoptilolite, properties of the Li–Al–Si systems, and kinetics of exchange are described. (J.R.D.)

**19713** (TID-7644(p.211-25)) ADSORPTION STUDIES BY THE U. S. GEOLOGICAL SURVEY. W. A. Beetem (Geological Survey, Denver).

A system containing dissolved Na, Ca, and a trace of Sr in contact with various minerals is reported. Tests with this system revealed that large increases of the Na concentration resulted in a reduction of Ca and Sr absorption with a corresponding reduction of the distribution coefficient ($K_d$) value for Sr. Experimental data on Ca–Na exchange on montmorillonite, kaolinite, and alkite are compared with theoretical results. (J.R.D.)

**19714** TREATMENT OF CONCENTRATED FISSION PRODUCTS SOLUTION. R. Bonniaud and C. Sombret. Bull. Inform. Sci. Tech. (Paris), 73-9(Nov. 1962). (In French)

The treatment of irradiated uranium rods produces among other effluents, residuary solutions containing fission products. These liquids which, after concentration, are in the form of a nitric acid solution of radioactive elements and of corrosion products, present important storage problems because of: their corrosive action, their very high activity, and the danger due to long-lived radioisotopes. In order to solve these problems a method was chosen which involves a solidification: the fission products are incorporated into glasses after a study of the compositions which most favor a high resistance to water, a substantial volume reduction factor, and a satisfactory resistance to radiation and to heat. For effluents obtained from the treatment of unalloyed uranium, a formula for silica glass was developed and tried out in a reinforced chamber. In the case where molybdenum is present in the solutions, it is necessary to make use of phosphorus glasses. Several methods can be used for making these glasses: a gelification followed by a crucible fusion, a discontinuous process; a calcination in a rotating oven followed by a fusion in an overflow oven, a continuous process; and a calcination followed by a fusion in the same tubular apparatus, then a casting, a semi-continuous process. These three processes have different advantages and disadvantages. The choice of the best method will depend on the results of tests on active solutions. (auth)

**19715** DISPOSAL OF SOLIDS AND USE OF SLUDGE FOR CONCENTRATING RADIOACTIVE WASTES. H. J. Blythe. Inst. Sewage Purif., J. Proc., 453-60(1962).

Sludges produced or used during the decontamination of radioactive liquids at Harwell are classified as to type and origin. Production of sludge is discussed including an ap-

praisal of the rectangular sludge blanket, pulsator, and upward-flow circular precipitators, and a consideration of sludge freezing and centrifuging. Included is a table describing the results of various treatment methods to Harwell sludges. Difficulties encountered with sludge disposal by dumping at sea, storage in tanks, and burial are discussed. (Public Health Eng. Abstr., 43: No. 3, March 1963)

**19716** LOW ACTIVITY WASTE TREATMENT BEFORE PERMANENT STORAGE. Eduard Malášek and Oldrich Žoch. Jaderna Energie, 9: 45-8(Feb. 1963). (In Czech)

The treatment (convenient processing and packaging) is of great importance for permanent storage of radioactive wastes. It leads to the increase of storage safety and to the lowering of operation and storage costs. Methods used for the treatment and packaging of individual types of low activity wastes in radioisotope user's sites in Czechoslovakia are evaluated and further outlook in this field is outlined. (auth)

**19717** REDUCING RADIOISOTOPE CONCENTRATIONS IN REACTOR EFFLUENT BY HIGH COAGULANT FEED. Wyatt B. Silker (General Electric Co., Richland, Wash.). J. Am. Water Works Assoc., 55: 355-68(Mar. 1963).

Beaker tests, dynamic tests using a model water treatment plant, and final tests on the coolant of one-half of a production reactor were carried out on a proposed water treatment process. By increasing the alum content from 4 to 18.5 ppm, a 75% decrease in the $As^{76}$ content, 60% for $P^{32}$, 57% for $Np^{239}$, and 25 to 30% for $Cr^{51}$, $Zn^{65}$, and $Cu^{64}$ was obtained in the effluent. Use of 20 ppm aluminum nitrate instead of alum gives similar decreases. (D.L.C.)

**19718** RADIUM REMOVAL FROM URANIUM MILL WASTE WATER. Herbert M. Schoen (Northeast Research Inst., Long Island, N. Y.). J. Walter Pollution Control Federation, 34: 1026-36(Oct. 1962).

A laboratory and theoretical study of the extraction of radium from an aqueous solution by foam separation is presented. Surface-active agents used were dodecylbenzyldiethylenetriaminetetraacetic acid, Igepon TC 42, and Aerosol 22. Radium solutions were about $10^{-10}$ M. The enrichment was affected by pH, but for each of the surface-active agents there was a pH range of similar effectiveness. The enrichment ratio (concentration of Ra in collapsed foam divided by concentration of Ra in bulk solution) in the more effective pH ranges generally had a value between 14 and 30. The enrichment ratio was nearly independent of radium concentration from $10^{-9}$ to $10^{-10}$ M. The results are in agreement with calculations based on the Gibbs adsorption isotherm. (Public Health Eng. Abstr., 43: No. 3, March 1963)

**19719** SINGLE STAGE VERTICAL EVAPORATOR (Engineering Materials). (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). 11 drawings. (CAPE-859)

An evaporator was designed to be used for the concentration of low-level or decayed high-level radioactive waste solutions. The waste solution is fed to the evaporator by a non-adjustable transfer-type steam jet with a capacity of 9 to 10 gpm or 6000 lbs per hour. The evaporator must be remotely controlled and must be located within concrete shielding walls to operate safely. (F.E.S.)

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**CALIFORNIA. UNIV., LIVERMORE. LAWRENCE RADIATION LAB.**
Bibliography on Be, 9/59–12/60, 17: 18675 (UCRL-5705(Suppl.1))
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Prog. rpt. on thermal properties of He and other fluids, 6/62–5/63, 17: 18769 (TID-18334)

**CONSOLIDATION COAL CO. RESEARCH AND DEVELOPMENT DIV., LIBRARY, PENNA.**
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**COPENHAGEN. UNIVERSITET.**
Isomer ratios for $Y^{87,87m}$, 17: 19226 (TID-16648)

**CORNELL AERONAUTICAL LAB., INC., BUFFALO.**
Prog. rpt. on outer-space environment models, final, 11/60–11/61, 17: 19686 (CAL-VG-1403-G-5)

**CORNELL UNIV., ITHACA, N. Y.**
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## D

**DAVID SARNOFF RESEARCH CENTER, PRINCETON, N. J.**
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**DEFENSE ATOMIC SUPPORT AGENCY. FIELD COMMAND, ALBUQUERQUE, N. MEX.**

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**DEL ELECTRONICS CORP., MOUNT VERNON, N. Y.**

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**DENMARK. ATOMENERGIKOMMISSIONEN. FORSØGSINSTITUT, RISØ.**

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**DEPARTMENT OF AGRICULTURE, BELTSVILLE, MD.**

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**DIVISION OF REACTOR DEVELOPMENT, AEC.**

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**DOW CHEMICAL CO. ROCKY FLATS DIV., DENVER.**

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**DU PONT DE NEMOURS (E. I.) & CO., WILMINGTON, DEL.**

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**DU PONT DE NEMOURS (E. I.) & CO. SAVANNAH RIVER PLANT, AIKEN, S. C.**

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**EUROPEAN ATOMIC ENERGY COMMUNITY.**

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**EUROPEAN ATOMIC ENERGY COMMUNITY. NUCLEAR RESEARCH CENTER, ISPRA, ITALY.**

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**EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH, GENEVA.**

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Problems of emulsion irradiations, 17: 18518 (CERN-63-3(p.103-10))

Proceedings of school on nuclear emulsion techniques, St. Cergue, 4/62, 17: 18510 (CERN-63-3)

Properties of beams with electrostatic separators, 17: 18515 (CERN-63-3 (p.69-79))

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## F

**FLUOR CORP., LTD., WHITTIER, CALIF.**

Prog. rpt. on nuclear reactors and saline water distillation, [1958], 17: 19633 (PB-161062)

**FORD MOTOR CO., DEARBORN, MICH.**

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**FORDHAM UNIV., NEW YORK.**

Environmental radioactivity in Brazil, 17: 18288 (A/AC.82/G/L.818)

**FRANCE. COMMISSARIAT À L'ÉNERGIE ATOMIQUE, PARIS.**

Structure of boundary layers of plasmas confined by magnetic fields, 17: 19449 (CEA-2245)

**FRANCE. COMMISSARIAT À L'ÉNERGIE ATOMIQUE. CENTRE D'ÉTUDES NUCLÉAIRES, CADARACHE.**

Plutonium-based fuel production programs, 17: 19560 (HW-75007(Paper 3))

**FRANCE. COMMISSARIAT À L'ÉNERGIE ATOMIQUE. CENTRE D'ÉTUDES NUCLÉAIRES, FONTENAY-AUX-ROSES.**

Plutonium as fuel for Rapsodie, 17: 19570 (HW-75007(Paper 15))

**FRANCE. COMMISSARIAT À L'ÉNERGIE ATOMIQUE. CENTRE D'ÉTUDES NUCLÉAIRES, SACLAY.**

Bibliography on microcalorimetry applied to radiation studies, 17: 18104 (CEA-Bib-25)

Measurement of Young's modulus. Application to nuclear graphites, 17: 18741 (CEA-2243)

**FRANKLIN INST., PHILADELPHIA.**

Tests pertaining to shipping containers for radioactive materials, 17: 18349 (TID-7651(p.238-64))

## G

**GENERAL ATOMIC DIV., GENERAL DYNAMICS CORP., SAN DIEGO, CALIF.**

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Hazards summary report for HTGR critical facility, 17: 19612 (GA-1210 and Add.)

Numerical method for radiation transport equation in plane geometry, 17: 19038 (GAMD-2874)

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Prog. rpt. on radiation effects on pressure transducers, final, 11/27/61–3/30/62, 17: 18508 (AFSWC-TDR-62-63)
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**GENERAL DYNAMICS/ASTRONAUTICS, SAN DIEGO, CALIF.**
Cherenkov radiation in a plasma, 17: 19466 (ZPh-118)
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**GENERAL DYNAMICS CORP. ELECTRIC BOAT DIV., GROTON, CONN.**
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**GENERAL DYNAMICS/FORT WORTH. DIV. OF GENERAL DYNAMICS CORP., FORT WORTH, TEX.**
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**GENERAL ELECTRIC CO. ATOMIC POWER EQUIPMENT DEPT., SAN JOSE, CALIF.**
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**GENERAL ELECTRIC CO. HANFORD ATOMIC PRODUCTS OPERATION, RICHLAND, WASH.**
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Fluidized-bed calcination studies with simulated ICPP waste, 17: 19698 (HW-65838RD)
Fluidized bed calcination of simulated Purex waste, 17: 19699 (HW-66384RD)
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Hot-cell studies on solidification of high-level wastes, 17: 19701 (HW-SA-2877)
LLESQS—program for calculation of least squares, 17: 18658 (HW-61265)
Melting behavior in $UO_2$–$PuO_2$, 17: 18747 (HW-SA-2640)
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Ozone hazards associated with operating of electron accelerator, 17: 19416 (HW-SA-2664)
Plutonium as power reactor fuel, 17: 19559 (HW-75007(Paper 1))
Proceedings of meeting on Pu as power reactor fuel, Richland, Wash., 9/62, 17: 19558 (HW-75007)
PRTR fuel element extractor, 17: 19578 (HW-76182)
Radiant-heat spray calcination for solidification of radioactive waste, 17: 19700 (HW-SA-2722)
Radioisotopes in body—diagnosis and treatment, 17: 17705 (HW-SA-2737)
Semiportable scintillation counter, 17: 18597 (HW-54676)

**GENERAL ELECTRIC CO. MISSILE AND SPACE DIV., VALLEY FORGE SPACE TECHNOLOGY CENTER, KING OF PRUSSIA, PENNA.**
Interaction of microwave radiation with weakly ionized gas, 17: 18903 (RADC-TDR-62-264)

**GENERAL ELECTRIC CO. VALLECITOS ATOMIC LAB., PLEASANTON, CALIF.**
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**GENERAL ELECTRIC CO. VALLECITOS ATOMIC LAB., SAN JOSE, CALIF.**
Euratom-AEC Pu recycle program, 17: 19568 (HW-75007(Paper D5))
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**GENERAL INSTRUMENT CORP., NEWARK, N. J.**
Power flattening for radioisotope-thermoelectric generators, 17: 18901 (NYO-9783)

**GENERAL MOTORS CORP. ALLISON DIV., INDIANAPOLIS.**
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**GEOLOGICAL SURVEY, DENVER.**
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**GEOLOGICAL SURVEY, WASHINGTON, D. C.**
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**GEORGIA INST. OF TECH., ATLANTA. ENGINEERING EXPERIMENT STATION.**
Prog. rpt. on high-temperature materials, 10–12/62, 17: 18718 (TID-18286)

**GEOSCIENCE LTD., SOLANA BEACH, CALIF.**
Prog. rpt. on heat transfer for auxiliary space nuclear power systems, 9–11/61, 17: 19689 (TID-15222)
Prog. rpt. on heat transfer for auxiliary space nuclear power systems, 12/61–2/62, 17: 19690 (TID-15223)
Prog. rpt. on heat transfer for auxiliary space nuclear power system, 3–5/62, 17: 19691 (TID-16052)
Prog. rpt. on heat transfer for auxiliary space nuclear power, annual, 9/61–8/62, 17: 18273 (TID-18028)

**GERMANY. PHYSIKALISCHES STAATSINSTITUT, HAMBURG.**
Discussion on processing of nuclear emulsions, 17: 18522 (CERN-63-3 (p.169-97))

**GERMANY. ZENTRALINSTITUT FUR KERNPHYSIK, DRESDEN.**
Explosion hazards of O concentration in N cryostats for reactor irradiation, 17: 18397 (ZFK-WF-18)

**GT. BRIT. NATIONAL INST. FOR RESEARCH IN NUCLEAR SCIENCE. RUTHERFORD HIGH ENERGY LAB., CHILTON, BERKS, ENGLAND.**
Accelerating tube for electrostatic generators, 17: 18540 (NIRL/R/21)
Programs for geometry calculations in scattering experiments, 17: 19218 (NIRL/R/22)

## H

**HAHN-MEITNER-INSTITUT FUR KERNFORSCHUNG BERLIN.**
Prog. rpt. on diffusion of fission gases in solids, 7–9/60, 17: 18762 (NP-12668)
Prog. rpt. on diffusion of fission gases in solids, 10–12/60, 17: 18763 (NP-12669)

**HARVARD UNIV., BOSTON.**
Secondary spectra from high-energy nuclear reactions, 17: 18376 (TID-7652(p.409-32))

**HARVARD UNIV., CAMBRIDGE, MASS.**
Excitation of plasma waves in unbounded homogeneous plasma, 17: 19445 (AD-283830)

**HEBREW UNIV., JERUSALEM.**
Hyperfine interactions of 2+ state in Dy-160, 17: 18888 (AD-284411)

**HONEYWELL RESEARCH CENTER, HOPKINS, MINN.**
Dislocations and tensile strength of MgO, 17: 18737 (AD-297058)

**HUGHES AIRCRAFT CO., CULVER CITY, CALIF.**
Prog. rpt. on collective protection equipment for AN/NSG-4 system, 4/15–5/30/62, 17: 18315 (AD-283680)

**HUGHES AIRCRAFT CO., MALIBU, CALIF.**
Prog. rpt. on p-i-n electron junction detectors, 7/62, 17: 18587 (AD-283836)
**HUGHES RESEARCH LABS. DIV. OF HUGHES AIRCRAFT CO., MALIBU, CALIF.**
Ion engine ground-testing facilities, 17: 19685 (AEDC-TDR-62-152)

## I

**IDAHO OPERATIONS OFFICE, AEC.**
Mineral reaction studies at NRTS, 17: 19709 (TID-7644(p.151-75))
**ILLINOIS INST. OF TECH., CHICAGO. ARMOUR RESEARCH FOUNDATION.**
Prog. rpt. on nuclear-photon energy conversion, final, 4/62–2/63, 17: 18215 (ASD-TDR-63-244)
**ILLINOIS. UNIV., URBANA.**
Redistribution of conduction electrons due to point defect complexes in metals, 17: 18905 (TID-16660)
**ILLINOIS. UNIV., URBANA. ENGINEERING EXPERIMENT STATION.**
Catalytic reduction processes, 17: 18011 (TID-18423)
**INDIANA UNIV., BLOOMINGTON.**
Direct reactions leading to low states of Be-8, 17: 19217 (LADC-5297)
**INSTITUT FOR TEORETISK FYSIK, COPENHAGEN.**
Discussion on processing of nuclear emulsions, 17: 18522 (CERN-63-3 (p.169-97))
Properties of photographic emulsions, 17: 18520 (CERN-63-3(p.129-50))
**INSTITUT "RUDJER BOŠKOVIČ, ZAGREB.**
Tunnel diode and common-base transistor circuit in fast electronics, 17: 18541 (RT/EL(62)18)
**INTERNATIONAL ATOMIC ENERGY AGENCY, VIENNA.**
Panel rpt. on light water lattices, Vienna, 5/62, 17: 18989
Theoretical physics lectures, Trieste, 1962, 17: 19518
Uranium–C and Pu–C systems, 17: 18849
**IOWA. STATE UNIV., IOWA CITY.**
Radiation belts of the earth, 17: 18355 (TID-7652(p.1-11))
**ISOTOPES, INC., WESTWOOD, N. J.**
Prog. rpt. on high altitude sampling program, 4/1/63, 17: 18329 (NYO-10495)
**ITALY. COMITATO NAZIONALE PER L'ENERGIA NUCLEARE, BOLOGNA.**
TRANSITO—program for calculating heat transfer in fast reactor, 17: 18270 (RT/FIMA(62)1)
**ITALY. COMITATO NAZIONALE PER L'ENERGIA NUCLEARE, ISPRA.**
TRANSITO—program for calculating heat transfer in fast reactor, 17: 18270 (RT/FIMA(62)1)
**ITALY. COMITATO NAZIONALE PER L'ENERGIA NUCLEARE, ROME.**
Tunnel diode and common-base transistor circuit in fast electronics, 17: 18541 (RT/EL(62)18)
**ITALY. COMITATO NAZIONALE PER L'ENERGIA NUCLEARE. LABORATORI NAZIONALI, FRASCATI.**
Effects of virtual vector mesons in $e^+e^-$ collisions, 17: 19041 (LNF-63/6)
**ITALY. ISTITUTO NAZIONALE DI FISICA NUCLEARE, ROME.**
Mean free path of 25-Bev protons in photographic emulsions, 17: 18601 (RT/FI(62)56)
**ITALY. ISTITUTO SPERIMENTALE DELLE FERROVIE DELLO STATO, ROME.**
Measurements of electron density gradients in orthogonal pinch, 17: 19459 (RT/FI(62)62)
**ITALY. ISTITUTO SUPERIORE DI SANITÀ, ROME.**
Organic semiconductors. Survey, 17: 18895 (ISS-62/16)
Photomultiplier gain stabilization circuit, 17: 18536 (ISS-62/40)

## J

**JAPAN ATOMIC ENERGY RESEARCH INST., TOKYO.**
Analysis of control system for British-type power reactors, 17: 19618 (JAERI-1042)
Corrosion of Al in $H_2O$, 17: 18698 (JAERI-1035)
Prog. rpt. on health physics, annual, 3/62, 17: 17624 (JAERI-5006)
Radiolysis of biphenyl, 17: 18105 (JAERI-1040)
Second power-up test for JRR-2, 17: 19670 (JAERI-1045)
Temperature rise of JRR-3 fuel element by decay heat, 17: 19669 (JAERI-1043)
**JOHNS HOPKINS UNIV., BALTIMORE.**
Conference on radioactive waste treatment, Washington, D. C., 8/62, 17: 19703 (TID-7644)
Decay asymmetries of charged Σ hyperons, 17: 19042 (NP-12650)
Theoretical consequences of accidents, 17: 18336 (TID-7651(p.18-30))

## K

**KERNFORSCHUNGSANLAGE, JÜLICH, GERMANY.**
Acceleration of plasma with electrode gun ring discharge, 17: 19452 (JUL-79-PP)
Comparison of Ag-activated metaphosphate glasses. II., 17: 18777 (AEC-tr-5723)
Isotopic exchange between H and liquid $NH_3$, 17: 18003 (JUL-31-PC)
Reactivity measurements with FRJ-1 (Merlin), 17: 19671 (JUL-70-RE)
Stationary plasma configuration in magnetic field, 17: 19451 (JUL-78-PP)
Technology of nuclear fuels, 17: 19582 (JUL-89-RE)
**KERNFORSCHUNGSZENTRUM, KARLSRUHE, GERMANY.**
Particle spectrometer. II., 17: 18598 (KFK-127)
**KNOLLS ATOMIC POWER LAB., SCHENECTADY, N. Y.**
Annealing of radiation damage in p-type PbTe, 17: 18857 (KAPL-2226)
Diffusion theory codes to predict γ heating, 17: 19040 (KAPL-M-DNA-5)
FICS—program to compute few-group constants within KARE diffusion theory system, 17: 19197 (KAPL-M-RPC-3(Rev.1))
SWAKRAUM—spatially dependent thermal spectrum code for Philco-2000, 17: 18659 (KAPL-M-FDF-2)
TER4—reactor transient analysis program, 17: 19583 (KAPL-M-SR-2)
TIGER—temperatures from internal generation rates, 17: 18261 (KAPL-M-EC-29)

## L

**LAUSANNE, SWITZERLAND. UNIVERSITÉ. ECOLE POLYTECHNIQUE. LABORATOIRE DE RECHERCHES NUCLÉAIRES.**
Magnetic moment of hyperons, 17: 18533 (CERN-63-3(p.361-75))
**LITTLE (ARTHUR D.) INC., CAMBRIDGE, MASS.**
Atomic energy deskbook, 17: 17636
**LOCKHEED MISSILES & SPACE CO., SUNNYVALE, CALIF.**
Bibliography on composite materials, 17: 18673 (SB-62-58)
**LONDON. UNIV. QUEEN MARY COLL.**
Heat transfer, rate of growth, and evaporation of liquid films, 17: 18269 (NP-12666)
**LONDON. UNIV. UNIVERSITY COLL.**
K-meson physics, 17: 18530 (CERN-63-3(p.315-23))
Scanning methods and statistics of emulsion measurements, 17: 18528 (CERN-63-3(p.275-96))
**LOS ALAMOS SCIENTIFIC LAB., N. MEX.**
Analysis of temperature distributions in stored irradiated LAMPRE capsules, 17: 19672 (LADC-5631)
Bounding of instabilities of PIC difference equations, 17: 18262 (LA-2414)
Cryogenic technology in nuclear rocket program, 17: 19619 (LADC-5458)
Direct reactions leading to low states of Be-8, 17: 19217 (LADC-5297)
Distribution of neutrons at ground-air interface, 17: 19198 (LA-2390 (Suppl.))
Elevated temperature diffusion bonding of W to W, 17: 18715 (LADC-5262)
Gamma-sensitive image intensifier tube, 17: 18539 (LADC-5541)
Graphite–hydrogen–methane kinetics above 1600°K, 17: 18004 (LADC-5453)
Linear time base precision and compound sweep concept, 17: 18538 (LADC-5407)
Loss of fission products from U–graphite fuel materials, 17: 18749 (LADC-5218)
Method for Eulerian fluid dynamics, 17: 18263 (LAMS-2826)
Neutron-induced U-235 fission at individual resonances, 17: 19220 (PNE-114F)
Nonstoichiometry in intermetallic compounds, 17: 18748 (LADC-5143)
Prog. rpt. on thermonuclear research, 2/20/63, 17: 19453 (LAMS-2874)
Reaction $Mg^{26}(He^3,\alpha)Mg^{25}$, 17: 19218 (LADC-5391)

Second order electric field due to conduction current, 17: 18897 (LADC-5443)
Turbulent viscosity in rotating He II, 17: 18896 (LADC-5318)

**LOVELACE FOUNDATION FOR MEDICAL EDUCATION AND RESEARCH, ALBUQUERQUE, N. MEX.**
Operating characteristics of Lauterbach and Dautrebande aerosol generators, 17: 18327 (LF-6)
Prog. rpt. on effects of blast from high explosives, 11/7/62, 17: 17622 (DASA-1336)
Prog. rpt. on medical aspects of nuclear blast, 11/62, 17: 18320 (DASA-1341)

**LYON. UNIVERSITÉ.**
Enrichment of binary gas mixtures, 17: 18652 (AEC-tr-5712)

## M

**MARQUARDT CORP., VAN NUYS, CALIF.**
Prog. rpt. on thermionic converter, final, 7/61–6/62, 17: 18889 (AD-284457)

**MARTIN-MARIETTA CORP. AEROSPACE DIV., BALTIMORE.**
Data telemetry package powered by Sr-90 generator, 17: 18898 (MND-SR-2428)
Radiation dosages from electrons and bremsstrahlung in Van Allen belts, 17: 18387 (TID-7652(p.760-72))

**MASSACHUSETTS INST. OF TECH., CAMBRIDGE.**
Axial field effects in magnetically driven shock tube, 17: 19458 (RLE-TR-408)
Calculation of pseudo-lattice energies in tetrahedral tetrachlorometallate(II) complexes, 17: 17947 (NYO-9873)
Crystal and molecular structure of bis Co(II) dinitrate, 17: 17948 (NYO-9874)
Electron-beam interaction with beam-generated plasma, 17: 19457 (RLE-TR-407)
Evidence for spin zero of $\eta$ from two-$\gamma$ decay mode, 17: 19043 (TID-16260)
Ion activity function for systems LiCl–$H_2O$ and LiBr–$H_2O$, 17: 18006 (TID-16696)
Neutron polarization by elastic scattering on C, O, and D, 17: 19045 (TID-16659)
Neutron strength function and shell model, 17: 19222 (TID-16603)
Prog. rpt. on ceramics, annual, 3/30/63, 17: 18774 (TID-18434)
Prog. rpt. on chemistry research, 5/62–5/63, 17: 17627 (NYO-2304)

**MAX-PLANCK-INSTITUT FÜR AERONOMIE. INSTITUT FUR STRATOSPHARENPHYSIK, LINDAU/HARZ, GERMANY.**
Time pattern of ionizing radiation in high latitudes, 17: 19010 (AD-284490)

**MAX-PLANCK-INSTITUT FÜR PHYSIK, MUNICH.**
Discussion on processing of nuclear emulsions, 17: 18522 (CERN-63-3 (p.169-97))
Purpose of school for emulsion physicists, 17: 18511 (CERN-63-3 (p.1-15))

**MELLON INST., PITTSBURGH.**
Methyl radical production in radiolysis of hydrocarbons, 17: 18107 (RRL-87)

**MEMORIAL HOSPITAL, NEW YORK.**
Effects of radiation exposure in man, 17: 18369 (TID-7652(p.269-74))

**MICHIGAN. UNIV., ANN ARBOR.**
Effect of sample orientation on counting rates in a neutron spectrometer, 17: 18605 (TID-18405)
Energy-dependent transport equation, 17: 19203 (TID-18428)
Heat capacities, thermodynamic properties and energy levels of Dy(III), Ho(III), and Er(III) oxides, 17: 18007 (TID-16744)
Investigation of collimator performance, 17: 18548 (TID-18397)
Prog. rpt. on irradiated beef, 7/59–6/60, 17: 18457 (AD-283644)
Prog. rpt. on neutron cross section and spectra studies, 2/63, 17: 18549 (TID-18408)
Slow neutron scattering, 17: 19204 (TID-18429)
Thin-walled sample holder for liquids, 17: 18551 (TID-18427)
Use of P-gram construction for calculation of chopper burst shapes, 17: 18547 (TID-18396)
Validity of Fermi approximation in slow neutron scattering, 17: 19228 (TID-18424)

**MICHIGAN. UNIV., ANN ARBOR. RESEARCH INST.**
Cavitation and erosion damage measurements with radioisotopes, 17: 18699 (NP-12648)

**MIDWESTERN UNIVERSITIES RESEARCH ASSN., MADISON, WIS.**
10-Bev high-intensity accelerator, 17: 19417 (NP-12655)

**MINE SAFETY APPLIANCES RESEARCH CORP., CALLERY, PENNA.**
Prog. rpt. on effect of 1200°F Na on steels, 5/62, 17: 18753 (MSAR-62-50)

**MINERALS AND CHEMICALS PHILIPP CORP., MENLO PARK, N. J.**
Alumino–silicate adsorbent for radioactive waste disposal, 17: 19712 (TID-7644(p.201-10))

**MINNESOTA. UNIV., MINNEAPOLIS.**
Radiation hazard due to solar cosmic rays, 17: 18356 (TID-7652 (p.12-32))

**MOUND LAB., MIAMISBURG, OHIO.**
Plutonium reactor fuels research at MLM, 17: 19564 (HW-75007(Paper D2))
Prog. rpt. on environmental monitoring, 7–9/61, 17: 18393 (TID-18316)
Prog. rpt. on environmental, 10–12/61, 17: 18394 (TID-18317)
Prog. rpt. on environmental monitoring, 4–6/62, 17: 18395 (TID-18318)
Prog. rpt., 10/62, 17: 17625 (MLM-1144)

**MSA RESEARCH CORP., CALLERY, PENNA.**
Prog. rpt. on effect of 1200°F Na on steels, 9–10/59, 17: 18750 (MSAR-59-133)
Prog. rpt. on effect of 1200°F Na on steels, 3/62, 17: 18751 (MSAR-62-33)
Prog. rpt. on effect of 1200°F Na on steels, 4/62, 17: 18752 (MSAR-62-41)
Prog. rpt. on effect of 1200°F Na on steels, 6/62, 17: 18754 (MSAR-62-77)
Prog. rpt. on effect of 1200°F Na on steels, 7/62, 17: 18755 (MSAR-62-92)
Prog. rpt. on effect of 1200°F Na on steels, 2/63, 17: 18756 (MSAR-63-47)

## N

**NAGOYA, JAPAN. UNIV.**
Motion of electrons in magnetic bottle, 17: 19450 (IPPJ-2)

**NATIONAL AERONAUTICS AND SPACE ADMINISTRATION, WASHINGTON, D. C.**
Long-range NASA shielding requirements, 17: 18382 (TID-7652(p.662-81))
Mission of man in space, 17: 18354 (TID-7652(p.vii-xvii))

**NATIONAL AERONAUTICS AND SPACE ADMINISTRATION. GODDARD SPACE FLIGHT CENTER, GREENBELT, MD.**
Composition of solar cosmic rays, 17: 18357 (TID-7652(p.33-43))
Individual solar particle events, 17: 18358 (TID-7652(p.44-85))

**NATIONAL AERONAUTICS AND SPACE ADMINISTRATION. LANGLEY RESEARCH CENTER, LANGLEY STATION, HAMPTON, VA.**
Effect of electron irradiation on composite foil for inflatable satellites, 17: 18368 (TID-7652(p.260-8))
Effects of protons on semiconductor devices, 17: 18365 (TID-7652 (p.220-9))
NASA Space Radiation Effects Laboratory, 17: 18364 (TID-7652 (p.201-20))

**NATIONAL AERONAUTICS AND SPACE ADMINISTRATION. LEWIS RESEARCH CENTER, CLEVELAND.**
Thermoluminescent spectra of NaCl and OH-free NaCl irradiated with 40-Mev $\alpha$ particles, 17: 18859 (NASA-TN-D-1662)

**NATIONAL AERONAUTICS AND SPACE ADMINISTRATION. MANNED SPACECRAFT CENTER, HOUSTON, TEX.**
Symposium on protection against radiation hazards in space, Gatlinburg, 11/62, 17: 18353 (TID-7652)

**NATIONAL BUREAU OF STANDARDS, BOULDER, COLO.**
Solar proton events deduced from radio observations, 17: 18359 (TID-7652(p.86-7))

**NATIONAL CANNERS ASSN. WESTERN RESEARCH LAB., BERKELEY, CALIF.**
Prog. rpt. on radiochemistry in food processing, annual, 2/63, 17: 18333 (SAN-1022)

**NATIONAL RESEARCH COUNCIL. BUILDING RESEARCH INST.**
Design for nuclear age, 17: 18221 (NAS-NRC-Pub-992)

**NATIONAL RESEARCH COUNCIL. COMMITTEE ON NUCLEAR SCIENCE.**
Symposium on applications of computers to nuclear and radiochemistry, Gatlinburg, 10/62, 17: 18660 (NAS-NS-3107)
**NATIONAL RESEARCH COUNCIL. MATERIALS ADVISORY BOARD.**
Materials research and development. Committee reports, 17: 18286 (MAB-187-M(Vol.II))
**NAVAL AIR DEVELOPMENT CENTER, JOHNSVILLE, PENNA.**
Proton precession magnetometer at NADC, 17: 18290 (NADC-AW-6226)
**NAVAL RADIOLOGICAL DEFENSE LAB., SAN FRANCISCO.**
Effects of 50- and 250-kvp x rays on dog, 17: 17767 (USNRDL-TR-616)
Maturation of liver function in chick embryo, 17: 17653 (USNRDL-TR-603)
**NAVAL SCHOOL OF AVIATION MEDICINE, PENSACOLA, FLA.**
LET spectrum and RBE of high-energy protons, 17: 18374 (TID-7652 (p.393-401))
**NEW ENGLAND CENTER HOSPITAL, BOSTON.**
Prog. rpt. on *in vivo* $\beta$-ray detectors and applications, 2/28/63. I and II., 17: 17763 (TID-18260)
**NEW HAMPSHIRE. UNIV., DURHAM.**
Variations in cosmic-ray nucleonic intensity, 17: 19011 (AFCRL-63-242)
**NEW YORK OPERATIONS OFFICE. HEALTH AND SAFETY LAB., AEC.**
Prog. rpt. on fallout program, 12/62–3/63, 17: 18322 (HASL-135)
**NEW YORK SHIPBUILDING CORP., CAMDEN, N. J.**
Savannah nuclear power summary test, 17: 19636 (TID-18325)
Savannah nuclear power operations at Camden, 17: 19637 (TID-18390)
**NEW YORK UNIV., NEW YORK.**
Passage of high-energy protons in dense matter, 17: 18391 (TID-7652 (p.852-65))
Prog. rpt. on computing and mathematics, 7–12/62, 17: 18663 (TID-18446)
**NORTH AMERICAN AVIATION, INC., DOWNEY, CALIF.**
Statistical prediction of solar proton events, 17: 18360 (TID-7652 (p.88-95))
**NORTH CAROLINA. UNIV., CHAPEL HILL.**
Mineral exchange at University of North Carolina, 17: 19704 (TID-7644 (p.13-28))
**NORTHROP CORP. NORTHROP SPACE LABS., HAWTHORNE, CALIF.**
Production of solar high-energy particles, 17: 18361 (TID-7652(p.96-117))
**NORTHWESTERN UNIV., EVANSTON, ILL.**
Decay asymmetries of charged $\Sigma$ hyperons, 17: 19042 (NP-12650)
Prog. rpt. on oxidation of Fe–Cr alloys, annual, 1962, 17: 18700 (TID-18420)
Prog. rpt. on thermophysical properties of plasmas, 3/15/60–3/14/62, 17: 19442 (AD-283512)
**NORWAY. INSTITUTT FOR ATOMENERGI, KJELLER.**
Polarized thermal neutron beams from magnetized mirrors, 17: 18537 (KR-37)
**NUCLEAR FUEL REPROCESSING STUDY TEAM.**
Fuel reprocessing study team report, 17: 18160 (NP-12670)
**NUCLEAR MATERIALS AND EQUIPMENT CORP., APOLLO, PENNA.**
Plutonium fuel development programs at NMEC, 17: 19562 (HW-75007 (Paper 9))
**NUCLEAR METALS, INC., CONCORD, MASS.**
Prog. rpt. on metallurgy, 1/63, 17: 18760 (NMI-2114)
**NUCLEAR SCIENCE AND ENGINEERING CORP., PITTSBURGH.**
Fallout radioactivity in Pittsburgh precipitation, 17: 18328 (NSEC-89)

## O

**OAK RIDGE GASEOUS DIFFUSION PLANT, TENN.**
Infrared spectra of Xe compounds, 17: 18008 (TID-18276)
**OAK RIDGE NATIONAL LAB., TENN.**
Cask testing program at ORNL, 17: 18348 (TID-7651(p.211-37))
Comparison of hand exposure data with film badge meter results, 17: 18331 (ORNL-TM-531)
Corrections to neutron activation of gold foils exposed in water, 17: 18600 (ORNL-3407)
Critical mass studies, XIII., 17: 19034 (ORNL-TM-499)
Effect of irradiation on hydrolysis of U carbides. I., 17: 18860 (ORNL-3403)
Effect of maximum brine temperature on output of large nuclear stations, 17: 19632 (ORNL-TM-536)
Hazards rpt. on aircraft reactor experiment, 17: 19627 (ORNL-1407)
IBM-7090 subroutine for making linear graphs using CALCOMP Plotter, 17: 18661 (ORNL-TM-430(Suppl.))
In-air measurements in vicinity of TSR-II, 17: 19677 (ORNL-3288)
Lifetime studies for NS *Savannah* reactor, 17: 19629 (ORNL-3261(Suppl.))
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Mineral exchange work at Oak Ridge, 17: 19711 (TID-7644(p.187-99))
Monte Carlo codes to transport nucleons through matter, 17: 18379 (TID-7652(p.608-18))
Nuclear secondaries from interactions of protons of few 100 Mev, 17: 18377 (TID-7652(p.523-94))
Nucleon-meson cascade calculations for accelerator shield design. III., 17: 19418 (ORNL-3412)
Nucleon-meson cascade calculations, 17: 18384 (TID-7652(p.698-712))
Prog. rpt. on Army reactors program, annual, ending 10/62, 17: 19630 (ORNL-3386)
Prog. rpt. on chemical development, 7–12/62, 17: 17949 (ORNL-TM-449)
Prog. rpt. on maritime reactor program, 11/30/62, 17: 19631 (ORNL-3416)
Purification of degraded TBP–hydrogen diluent solutions, 17: 18178 (ORNL-3203)
Radiation dose in tissue from high-energy protons, 17: 18380 (TID-7652(p.619-32))
Radiation safety and control at ORNL, 17: 18330 (ORNL-TM-507)
Relationship of RBE and LET, 17: 18375 (TID-7652(p.402-8))
Solvent extraction of $UO_2(NO_3)_2$ and $HNO_3$, 17: 18179 (ORNL-TM-358)
Steam generators for high-temperature GCR, 17: 19628 (ORNL-3208)
Summary of publications involving uses of electromagnetically enriched stable isotopes, 17: 17628 (ORNL-3266)
Symposium on protection against radiation hazards in space, Gatlinburg, 11/62, 17: 18353 (TID-7652)
**OFFICE OF TECHNICAL SERVICES, WASHINGTON, D. C.**
Bibliography on welding, 17: 18728
**OFFICE OF THE CHIEF OF TRANSPORTATION, WASHINGTON, D. C.**
Proposed study of rail and highway transport systems during credible accident, 17: 18351 (TID-7651(p.315-30))
**OHIO STATE UNIV. RESEARCH FOUNDATION, COLUMBUS.**
Magnetic-ionic theory for bound electrons, 17: 18891 (AFCRL-62-766)
Radiation from elementary dipoles in magnetic-ionic medium, 17: 19447 (AD-284475)
**OREGON. AGRICULTURAL EXPERIMENT STATION, CORVALLIS.**
Prog. rpt. on irradiation of foods, 1/2/60–2/28/62, 17: 18459 (AD-284068)

## P

**PENNSYLVANIA STATE UNIV., UNIVERSITY PARK.**
Prog. rpt. on high-temperature materials, annual, 3/12/63, 17: 18772 (TID-18412)
**PENNSYLVANIA. UNIV., PHILADELPHIA.**
Prog. rpt. on forming pseudo silicides, 1–9/62, 17: 18668 (AFOSR-2647)
Prog. rpt. on structure of NbAs, 1–9/62, 17: 18738 (AFOSR-2645)
**PHILLIPS PETROLEUM CO. ATOMIC ENERGY DIV., IDAHO FALLS, IDAHO.**
Chempump performance for high-temperature organic service, 17: 18218 (IDO-16844)
In-line analysis for $HNO_3$ and salt concentrations, 17: 18176 (IDO-14603)
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**PICATINNY ARSENAL, DOVER, N. J.**
Plasma acceleration and diagnostics, 17: 19446 (AD-284381)
**POLISH ATOMIC ENERGY COMMISSION. INFORMATION CENTER, WARSAW.**
Nuclear radiation detectors, 17: 18599 (NP-12587)

**PONTIFÍCIA UNIVERSIDADE CATÔLICA, RIO DE JANEIRO.**
Environmental radioactivity in Brazil, 17: 18288 (A/AC.82/G/L.818)
**PRINCETON UNIV., N. J.**
High-frequency conductivity and emission and absorption coefficients of fully ionized plasma, 17: 19454 (MATT-137)
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Because of problems involving the mechanical preparation of this index, all accent marks are omitted. The following changes in spelling have been introduced to reduce some of the confusion which might result from omitting the accents:

| | | |
|---|---|---|
| Æ | becomes | ae |
| ö | | oe |
| ø | | oe |
| ü | | ue (except in transliterated Chinese names) |

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**As an aid to the users of this index, references to report numbers, where appropriate, are included after the abstract number of the citation.**

**The number preceding the colon is the *NSA* volume number, and the number following is the abstract number in that volume. The designation (R) following the abstract number indicates that the abstract is of a progress report; (P) indicates a patent; and (T) indicates a translation. Abstracts for reports other than progress reports carry no letter designation. Published literature (journal article or book) is identifiable by the absence of a report number.**

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Applications of Computers to Nuclear and Radiochemistry, Gatlinburg, Tennessee, Oct. 17–19, 1962, 17: 18660 (NAS-NS-3107)
Atom Forum 1962, Washington, D. C., Nov. 26 to 28, 1962, 17: 19657
Atomic Energy Commission Welding Forum, Chicago, Oct. 1959, 17: 18717 (TID-7624)
Business Opportunities in the Nuclear Space Program, Washington, D. C., Nov. 29, 1962, 17: 19695
Conference of the Building Research Institute, Design for Nuclear Age, Fall 1961, 17: 18221 (NAS-NRC-Pub-992)
Fifth Annual Symposium on Tracer Methodology, Washington, D. C., October 20, 1961, 17: 18469
First Berkeley International Materials Conference "The Impact of Transmission Electron Microscopy on Theories of Strength of Crystals," University of California, Berkeley, July 5 to 8, 1961, 17: 18088
Nuclear Photography, Moscow, July 1960, 17: 17635
Pediatrics and Nuclear Medicine, Brookhaven Lab., March 1961, 17: 17674
Plutonium As a Power Reactor Fuel, Richland, Washington, Sept. 13 and 14, 1962, 17: 19558 (HW-75007)
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Symposium on Pressure Vessel Research Towards Better Design, London, January 18–19, 1961, 17: 18246
Use of Inorganic Exchange Materials for Radioactive Waste Treatment, Washington, D. C., Aug. 13 and 14, 1962, 17: 19703 (TID-7644)
Using the Nuclear Emulsion Technique in Conjunction with the CERN Proton Synchrotron and Synchro-Cyclotron, St. Cergue, Switzerland, April 8-18, 1962, 17: 18510 (CERN-63-3)

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| 5982 | 17-18119 | See BNL-6016 |
| 6016 | 17-18119 | Intern. J. Appl. Radiation Isotopes 13: 641-5(1962) |
| 6061 | 17-17646 | Ann. Rev. Nucl. Sci. 12: 285-328(1962) |
| 6093 | 17-17645 | Ann. Rev. Nucl. Sci. 12: 243-84(1962) |
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| 6249 | 17-18852 | Dep.(mc); $5.60(fs), $1.88(mf) OTS |
| 6253 | 17-17753 | Dep.(mc); $1.60(fs), $0.80(mf) OTS |
| 6257 | 17-18102 | Dep.(mc); $2.60(fs), $1.01(mf) OTS |
| 6274 | 17-17754 | Dep.(mc); $2.60(fs), $0.83(mf) OTS |
| 6276 | 17-17755 | Dep.(mc); $1.60(fs), $0.80(mf) OTS |
| 6277 | 17-18893 | Dep.(mc); $3.60(fs), $1.13(mf) OTS |
| 6278 | 17-18092 | Dep.(mc); $1.60(fs), $0.80(mf) OTS |
| 6279 | 17-17944 | Dep.(mc); $3.60(fs), $1.13(mf) OTS |
| 6392 | 17-19285 | Nucl. Phys. 41: 159-66(1963) |
| 6395 | 17-18956 | Phys. Rev. 130: 693-707(1963) |
| 6457 | 17-19316 | Nucl. Phys. 41: 604-7(1963) |
| 6479 | 17-18045 | J. Chem. Phys. 38: 1115-22(1963) |
| 6509 | 17-17866 | N. Y. State J. Med. 63: 691-8(1963) |
| 6539 | 17-19141 | Phys. Rev. 130: 1188-1209(1963) |
| 6555 | 17-19343 | Phys. Rev. 130: 727-30(1963) |
| 6573 | 17-19131 | Phys. Rev. 130: 786-90(1963) |
| 6582 | 17-19355 | Phys. Rev. 130: 1127-30(1963) |
| 6760 | 17-19150 | Phys. Rev. Letters 10: 262-5(1963) |
| 6761 | 17-19151 | Phys. Rev. Letters 10: 266-7(1963) |
| 6842 | 17-18853 | Dep.(mc); $3.60(fs), $1.28(mf) OTS |
| 6849 | 17-18103 | Dep.(mc); $4.60(fs), $1.49(mf) OTS |
| 6852 | 17-17945 | Dep.(mc); $5.60(fs), $1.91(mf) OTS |
| 6880 | 17-19410 | Dep.(mc); $1.10(fs), $0.80(mf) OTS |
| 6885 | 17-18590 | Dep.(mc); $2.60(fs), $1.04(mf) OTS |
| 6889 | 17-18591 | Dep.(mc); $1.60(fs), $0.80(mf) OTS |
| 6899 | 17-18592 | Dep.(mc); $1.10(fs), $0.80(mf) OTS |
| 6902 | 17-19411 | Dep.(mc); $4.60(fs), $0.52(mf) OTS |
| 6906 | 17-18509 | Dep.(mc); $1.10(fs), $0.80(mf) OTS |
| 6922 | 17-19412 | Dep.(mc); $1.10(fs), $0.80(mf) OTS |
| **BNL-PR–** | | |
| 1 | 17-18671 | See BNL-788 |
| **BNL-T–** | | |
| 290 | 17-19409 | See BNL-772 |
| 291 | 17-19554 | See BNL-774 |
| **BRB–** | | |
| 70 | 17-18710 | Dep.(mc); $6.60(fs), $2.12(mf) OTS |
| **CAL-VG–** | **(Non-AEC)** | |
| 1403-G-5 | 17-19686 | $2.25(OTS) |
| **CAPE–** | | |
| 859 | 17-19719 | EM |
| 890 | 17-18647 | EM |
| 905 | 17-18000 | EM |
| 924 | 17-18453 | EM |
| 928 | 17-19503 | EM |
| 929 | 17-19504 | EM |
| 930 | 17-18245 | EM |
| **CEA–** | **(French)** | |
| 2243 | 17-18741 | Dep.(mc) |
| 2245 | 17-19449 | Dep.(mc) |
| 2246 | 17-19680 | 11p. of Onde Elec. No. 427 (1962) |
| 2247 | 17-18575 | 7p. of Onde Elec. No. 427 (1962) |
| **CEA-Bib–** | **(French)** | |
| 25 | 17-18104 | Dep.(mc) |
| **CEA-tr–** | **(French)** | |
| R-1632 | 17-17768 | Dep.(mc); $1.60(fs), $0.80(mf) JCL or OTS |
| R-1639 | 17-18702 | Dep.(mc); $1.60(fs), $0.80(mf) JCL or OTS |
| **CEAL–** | | |
| 1001 | 17-19413 | Dep.(mc); $2.60(fs), $0.83(mf) OTS |
| 1002 | 17-19414 | Dep.(mc); $1.60(fs), $0.80(mf) OTS |
| 1003 | 17-19415 | Dep.(mc); $1.60(fs), $0.80(mf) OTS |
| **CEAL-TM–** | | |
| 102 | 17-18216 | Dep.(mc); $3.60(fs), $1.22(mf) OTS |
| **CERN–** | **(European Organization for Nuclear Research)** | |
| 63-3 | 17-18510 | Dep.(mc) |
| 63-4 | 17-18593 | Dep.(mc) |
| 63-6 | 17-18594 | Dep.(mc) |
| **CF–** | **(Misc.)** | |
| 2977* | 17-18899 | See NP-12343 |
| **CRCE–** | **(Canadian)** | |
| 1142 | 17-19555 | Dep.; $0.50(AECL) |
| **CRFD–** | **(Canadian)** | |
| 1117 | 17-18854 | Dep.; $1.50(AECL) |
| **CRGP–** | **(Canadian)** | |
| 956 | 17-18595 | Dep.; $1.50(AECL) |
| **CRRD–** | **(Canadian)** | |
| 1136 | 17-18319 | Dep.; $0.50(AECL) |
| **CRRP–** | **(Canadian)** | |
| 1140 | 17-19196 | Dep.; $1.00(AECL) |
| **CU–** | **(Misc.)** | |
| 20-62-AF-350-EE* | 17-18289 | See AFOSR-2764 |
| **DASA–** | **(Misc.)** | |
| 1336* | 17-17622 | |
| 1341* | 17-18320 | |
| **DCAS-TDR–** | **(Non-AEC)** | |
| 62-62 | 17-18742 | |

| Report No. | Abstract No. | Availability |
|---|---|---|
| **DEG-Report-** | **(British)** | |
| 234 | 17-18217 | Dep.; $0.35(BIS); 2s. 6d. (HMSO) |
| **DP-** | | |
| 371 | 17-18172 | Dep.(mc); $2.60(fs), $0.89(mf) OTS |
| 447 | 17-18173 | Dep.(mc); $1.60(fs), $0.80(mf) OTS |
| 471 | 17-18596 | Dep.(mc); $1.60(fs), $0.80(mf) OTS |
| 493 | 17-18711 | Dep.(mc); $2.60(fs), $0.92(mf) OTS |
| 580 | 17-18174 | Dep.(mc); $1.60(fs), $0.80(mf) OTS |
| 713 | 17-19697 | Dep.(mc); $2.60(fs), $0.89(mf) OTS |
| 806 | 17-19556 | Dep.; $1.25(OTS) |
| 813 | 17-18766 | See TID-16676 |
| 825 | 17-19611 | Dep.; $1.25(OTS) |
| **DPSPU-** | | |
| 63-30-8 | 17-18321 | Dep.(mc); $1.60(fs), $0.80(mf) OTS |
| **DPST-** | | |
| 62-71-4 | 17-18697 | Dep.(mc); $1.60(fs), $0.80(mf) OTS |
| **EDR-** | **(Non-AEC)** | |
| 2978 | 17-18894 | $3.60(OTS) |
| **EFINS-** | **(Misc.)** | |
| 62-49 | 17-19279 | Nucl. Phys. 41: 78-91(1963) |
| **EGCR-STUDY-II-** | | |
| 401 | 17-19635 | See TID-18314 |
| **EP-** | **(Misc.)** | |
| 4422-198-62S | 17-18223 | See UVA-198-62S |
| 4422-245-62S | 17-18275 | See UVA-245-62S |
| **EUR-** | **(European Atomic Energy Community)** | |
| 132.f | 17-18743 | Dep.(mc) |
| 165.e | 17-17946 | Dep.(mc) |
| **EURAEC-** | | |
| 19 | 17-18764 | See NYO-9047 |
| 470 | 17-18720 | Dep.(mc); $1.60(fs), $0.80(mf) OTS |
| 576 | 17-19557 | See GEAP-4161 |
| 577 | 17-18713 | See GEAP-4115 |
| **FTD-TT-** | **(Non-AEC)** | |
| 62-1301 | 17-19468 | OTS |
| 62-1473 | 17-18679 | OTS |
| 62-1719 | 17-18912 | $1.60(fs) JCL or OTS |
| 62-1724 | 17-18226 | $1.50(fs) JCL or OTS |
| 62-1734 | 17-19469 | OTS |
| 62-1789 | 17-18721 | OTS |
| 62-1797 | 17-18913 | OTS |
| 62-1810 | 17-18914 | OTS |
| 62-1893 | 17-18915 | OTS |
| 63-68 | 17-19426 | $1.10(fs) OTS |
| **GA-** | **(Misc.)** | |
| 1210 & Add. | 17-19612 | Dep.(mc); $8.60(fs), $3.17(mf) OTS |
| 3128 | 17-19613 | Dep.(mc); $5.60(fs), $1.73(mf) OTS |
| 3367 | 17-18744 | Dep.(mc); Appl. Phys. Letters, 2: 165-7 (1963) |
| 3799 | 17-19614 | Dep.(mc); $6.60(fs), $2.15(mf) OTS |
| **GAMD-** | **(Misc.)** | |
| 2874* | 17-19038 | |
| 3074* | 17-19039 | |
| 3977 | 17-19615 | Dep.(mc); $8.10(fs), $2.87(mf) OTS |
| **GEAP-** | **(Misc.)** | |
| 3918 | 17-18712 | Dep.; $2.00(OTS) |
| 4115 | 17-18713 | Dep.(mc); $3.60(fs), $1.28(mf) OTS |
| 4161 | 17-19557 | Dep.(mc); $2.60(fs), $0.83(mf) OTS |

| Report No. | Abstract No. | Availability |
|---|---|---|
| **GLR-** | | |
| 6 | 17-19689 | See TID-15222 |
| 8 | 17-19690 | See TID-15223 |
| 9 | 17-19691 | See TID-16052 |
| 10 | 17-18273 | See TID-18028 |
| **GSG-** | **(Non-AEC)** | |
| 1663.00/54 | 17-18315 | See AD-283680 |
| **HASL-** | | |
| 135 | 17-18322 | Dep.; $4.00(OTS) |
| **HE-** | **(Misc.)** | |
| 150-204 | 17-18745 | Dep.(mc); $8.10(fs), $2.66(mf) OTS |
| **HR-** | **(Non-AEC)** | |
| 63-252 | 17-18737 | See AD-297058 |
| **HW-** | | |
| 54676 | 17-18597 | Dep.(mc); $1.60(fs), $0.80(mf) OTS |
| 55856 | 17-17756 | $3.60(fs), $1.13(mf) OTS |
| 61265 | 17-18658 | $1.10(fs), $0.80(mf) OTS |
| 65838RD | 17-19698 | Dep.(mc); $1.60(fs), $0.80(mf) OTS |
| 66384RD | 17-19699 | Dep.(mc); $2.60(fs), $1.04(mf) OTS |
| 69738 | 17-18158 | Dep.(mc); $1.60(fs), $0.80(mf) OTS |
| 73891(Rev.) | 17-18323 | Dep.(mc); $1.60(fs), $0.80(mf) OTS |
| 75007 | 17-19558 | Dep.(mc); $6.00(OTS) |
| 75484 | 17-18746 | Dep.(mc); $3.60(fs), $1.22(mf) OTS |
| 76182 | 17-19578 | Dep.(mc); $1.60(fs), $0.80(mf) OTS |
| 76944 | 17-18324 | Dep.(mc); $2.60(fs), $0.95(mf) OTS |
| **HW-SA-** | | |
| 2229 | 17-18855 | $1.10(fs), $0.80(mf) OTS |
| 2585 | 17-18420 | Health Phys. 9: 236-8(1963) |
| 2640 | 17-18747 | Dep.(mc); $2.60(fs), $1.04(mf) OTS |
| 2645 | 17-18001 | Dep.(mc); $1.60(fs), $0.80(mf) OTS |
| 2663 | 17-17966 | Dep.(mc); $1.10(fs), $0.80(mf) OTS |
| 2664 | 17-19416 | Dep.(mc); $1.60(fs), $0.83(mf) OTS |
| 2697 | 17-18159 | Dep.(mc); $1.60(fs), $0.80(mf) OTS |
| 2722 | 17-19700 | Dep.(mc); $2.60(fs), $0.95(mf) OTS |
| 2730 | 17-18325 | Dep.(mc); $3.60(fs), $0.86(mf) OTS |
| 2737 | 17-17705 | Dep.(mc); $1.10(fs), $0.80(mf) OTS |
| 2877 | 17-19701 | Dep.(mc); $4.60(fs), $1.46(mf) OTS |
| 2958 | 17-19702 | Dep.(mc); $6.60(fs), $2.12(mf) OTS |
| 2959 | 17-18175 | Dep.(mc); $3.60(fs), $1.16(mf) OTS |
| **IDO-** | | |
| 14603 | 17-18176 | Dep.; $0.50(OTS) |
| 16428(Rev.1) | 17-19579 | Dep.; $1.75(OTS) |
| 16819 | 17-19668 | Dep.; $2.25(OTS) |
| 16827 | 17-17623 | Dep.; $1.50(OTS) |
| 16829 | 17-19580 | Dep.; $1.00(OTS) |
| 16835 | 17-19616 | Dep.; $1.25(OTS) |
| 16836 | 17-18535 | Dep.; $1.00(OTS) |
| 16844 | 17-18218 | Dep.; $0.50(OTS) |
| 16846 | 17-18326 | Dep.(mc); $4.60(fs), $1.58(mf) OTS |
| 28578 | 17-19617 | Dep.; $1.50(OTS) |
| 28600 | 17-18856 | Dep.; $1.00(OTS) |
| **IPPJ-** | **(Japanese)** | |
| 2 | 17-19450 | Dep.(mc) |
| **IS-** | | |
| 494 | 17-19216 | Nucl. Phys., 40: 670-89(1963) |
| 495 | 17-17986 | Anal. Chim. Acta 28: 164-9(1963) |
| 502 | 17-18057 | J. Opt. Soc. Am. 53: 298-9(1963) |
| 512 | 17-17959 | J. Chem. Phys. 38: 1211-15(1963) |
| 552 | 17-19311 | Nucl. Phys. 41: 524-8(1963) |
| 602 | 17-19362 | Phys. Rev. Letters 10: 250-3(1963) |
| 604 | 17-18970 | Phys. Rev. Letters 10: 227-9(1963) |
| 634 | 17-18002 | Dep.(mc); $3.60(fs), $1.22(mf) OTS |

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|---|---|---|
| **ISC–** | | |
| 1076 | 17-18687 | J. Chem. Educ. 37: 56-68(1960) |
| **ISS–** | **(Italian)** | |
| 62/16 | 17-18895 | Dep.(mc) |
| 62/40 | 17-18536 | Dep.(mc) |
| **JAERI–** | **(Japanese)** | |
| 1035 | 17-18698 | Dep.(mc) |
| 1040 | 17-18105 | |
| 1042 | 17-19618 | Dep.(mc) |
| 1043 | 17-19669 | |
| 1045 | 17-19670 | |
| 5006 | 17-17624 | |
| **JPL-TR–** | **(Non-AEC)** | |
| 32-385 | 17-19581 | $3.60(fs), $1.31(mf) OTS |
| **JPRS–** | **(Non-AEC)** | |
| 17876 | 17-19667 | $1.75(OTS) |
| 18395 | 17-17769 | $6.00(OTS) |
| 18455 | 17-18292 | $4.00(OTS) |
| 18479 | 17-17783 | $0.50(OTS) |
| 18492 | 17-17707 | $1.00(OTS) |
| 18505 | 17-19427 | $0.50(OTS) |
| 18548(Excerpt) | 17-17738 | OTS |
| 18632 | 17-17977 | $0.50(OTS) |
| **JÜL–** | **(German)** | |
| 31-PC | 17-18003 | Dep.(mc) |
| 70-RE | 17-19671 | Dep.(mc) |
| 78-PP | 17-19451 | Dep.(mc) |
| 79-PP | 17-19452 | Dep.(mc) |
| 87-PP | 17-19501 | 92p. of "Production of High Temperature Plasma by Magnetic Compression." Cologne and Opladen, Westdeutscher Verlag, 1962 |
| 89-RE | 17-19582 | Dep.(mc) |
| **KAPL–** | | |
| 2226 | 17-18857 | Dep.(mc); $3.60(fs), $1.28(mf) OTS |
| **KAPL-M–** | | |
| DNA-5 | 17-19040 | Dep.(mc); $5.60(fs), $1.91(mf) OTS |
| EC-29 | 17-18261 | Dep.(mc); $8.60(fs), $2.63(mf) OTS |
| FDF-2 | 17-18659 | Dep.(mc); $4.60(fs), $1.67(mf) OTS |
| RPC-3(Rev.1) | 17-19197 | Dep.(mc); $8.10(fs), $2.75(mf) OTS |
| SR-2 | 17-19583 | Dep.(mc); $7.60(fs), $2.39(mf) OTS |
| **KFK–** | **(German)** | |
| 127 | 17-18598 | Dep.(mc) |
| **KR–** | **(Norwegian)** | |
| 37 | 17-18537 | Dep.(mc) |
| **LA–** | | |
| 2390(Suppl.) | 17-19198 | Dep.; $2.25(OTS) |
| 2414 | 17-18262 | Dep.; $1.50(OTS) |
| 2751 | 17-18714 | Dep.; $5.60(fs), $1.82(mf) OTS |
| **LADC–** | | |
| 5143 | 17-18748 | Dep.(mc); $2.60(fs), $0.86(mf) OTS |
| 5154 | 17-18637 | Rev. Sci. Instr. 34: 274-7(1963) |
| 5218 | 17-18749 | Dep.(mc); $2.60(fs), $0.92(mf) OTS |
| 5262 | 17-18715 | Dep.(mc); $3.60(fs), $1.19(mf) OTS |
| 5297 | 17-19217 | Dep.(mc); $1.10(fs), $0.80(mf) OTS |
| 5318 | 17-18896 | Dep.(mc); $1.10(fs), $0.80(mf) OTS |
| 5391 | 17-19218 | Dep.(mc); $1.10(fs), $0.80(mf) OTS |
| 5407 | 17-18538 | Dep.(mc); $8.60(fs), $3.02(mf) OTS |
| 5443 | 17-18897 | Dep.(mc); $1.60(fs), $0.80(mf) OTS |
| 5453 | 17-18004 | Dep.(mc); $2.60(fs), $0.86(mf) OTS |
| 5458 | 17-19619 | Dep.(mc); $1.60(fs), $0.80(mf) OTS |
| 5502 | 17-19016 | J. Geophys. Res. 68: 657-61(1963) |
| 5541 | 17-18539 | Dep.(mc); $2.60(fs), $1.07(mf) OTS |
| 5542 | 17-18100 | J. Chem. Phys. 38: 1023-4(1963) |
| 5557 | 17-18046 | J. Chem. Phys. 38: 1123-31(1963) |
| 5631 | 17-19672 | Dep.(mc); $4.60(fs), $1.58(mf) OTS |
| 5651 | 17-19360 | Phys. Rev. Letters 10: 246-7(1963) |
| **LAMS–** | | |
| 2826 | 17-18263 | Dep.; $2.25(OTS) |
| 2874 | 17-19453 | Dep.; $0.75(OTS) |
| **LF–** | | |
| 6 | 17-18327 | Dep.; $0.75(OTS) |
| **LNF–** | **(Italian)** | |
| 63/6 | 17-19041 | Dep.(mc) |
| **MAB–** | **(Non-AEC)** | |
| 187-M(Vol.II) | 17-18286 | |
| **MATT–** | | |
| 137 | 17-19454 | Dep.(mc); $1.60(fs), $0.80(mf) OTS |
| **MATT-Trans–** | | |
| 3 | 17-19470 | Dep.(mc); $3.60(fs), $1.28(mf) JCL or OTS |
| 4 | 17-19471 | Dep.(mc); $1.60(fs), $0.80(mf) JCL or OTS |
| 5 | 17-19472 | Dep.(mc); $1.10(fs), $0.80(mf) JCL or OTS |
| **MLM–** | | |
| 1144 | 17-17625 | Dep.; $2.60(fs), $1.10(mf) OTS |
| **MND-SR–** | | |
| 2428 | 17-18898 | Dep.(mc); $11.00(fs), $4.46(mf) OTS |
| **MPR-X–** | | |
| III-2-63 | 17-18274 | See TID-18296 |
| **MRL–** | **(Non-AEC)** | |
| 120 | 17-17645 | See BNL-6093(AEC) |
| **MRL-TDR–** | **(Non-AEC)** | |
| 6204 | 17-19686 | See CAL-VG-1403-G-5 |
| **MSAR–** | **(Misc.)** | |
| 59-133 | 17-18750 | Dep.(mc); $6.60(fs), $2.03(mf) OTS |
| 62-33 | 17-18751 | Dep.(mc); $1.60(fs), $0.80(mf) OTS |
| 62-41 | 17-18752 | Dep.(mc); $1.10(fs), $0.80(mf) OTS |
| 62-50 | 17-18753 | Dep.(mc); $1.60(fs), $0.80(mf) OTS |
| 62-77 | 17-18754 | Dep.(mc); $1.60(fs), $0.80(mf) OTS |
| 62-92 | 17-18755 | Dep.(mc); $2.60(fs), $0.92(mf) OTS |
| 63-47 | 17-18756 | Dep.(mc); $1.60(fs), $0.80(mf) OTS |
| **N–** | **(Misc.)** | |
| 62-10486* | 17-19448 | See A&ES-62-1 |
| 63-14413* | 17-19581 | See JPL-TR-32-385 |
| **NAA-SR–** | | |
| 3220 | 17-19673 | Dep.(mc); $12.00(fs), $5.27(mf) OTS |
| 6309 | 17-18264 | Dep.(mc); $13.00(fs), $5.72(mf) OTS |
| 7660 | 17-18177 | Dep.; $0.50(OTS) |
| 7752 | 17-18672 | Dep.; $0.50(OTS) |
| 7770 | 17-19199 | Dep.; $0.50(OTS) |
| 7797 | 17-19687 | Dep.; $1.25(OTS) |
| 7925 | 17-19674 | Dep.; $1.50(OTS) |
| 7973 | 17-18716 | Dep.; $1.00(OTS) |
| 8097 | 17-19688 | Dep.; $1.00(OTS) |
| 8171 | 17-18265 | Dep.; $1.00(OTS) |
| **NAA-SR-Memo–** | | |
| 5001 | 17-19509 | Dep.(mc); $2.60(fs), $0.83(mf) OTS |

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| 6873 & Add.1 | 17-18266 | Dep.(mc); $1.60(fs), $0.80(mf) OTS |
| 7343 | 17-19584 | Dep.(mc); $8.60(fs), $2.96(mf) OTS |
| 7594 | 17-19620 | Dep.(mc); $1.10(fs), $0.80(mf) OTS |
| 7861 | 17-18757 | Dep.(mc); $1.10(fs), $0.80(mf) OTS |
| 7878 | 17-19621 | Dep.(mc); $3.60(fs), $1.16(mf) OTS |
| 7879 | 17-19622 | Dep.(mc); $1.10(fs), $0.80(mf) OTS |
| 7940 | 17-19200 | Dep.(mc); $2.60(fs), $1.04(mf) OTS |
| 7953 | 17-19675 | Dep.(mc); $2.60(fs), $0.89(mf) OTS |
| 7982 | 17-19676 | Dep.(mc); $1.60(fs), $0.80(mf) OTS |
| 8011 | 17-19623 | Dep.(mc); $7.60(fs), $2.39(mf) OTS |
| 8018 | 17-18267 | Dep.(mc); $1.60(fs), $0.80(mf) OTS |
| 8022 | 17-19624 | Dep.(mc); $2.60(fs), $0.92(mf) OTS |
| 8033 | 17-18858 | Dep.(mc); $6.60(fs), $2.15(mf) OTS |
| 8035 | 17-18219 | Dep.(mc); $1.60(fs), $0.80(mf) OTS |
| 8041 | 17-19625 | Dep.(mc); $1.60(fs), $0.80(mf) OTS |
| 8052 | 17-18758 | Dep.(mc); $3.60(fs), $1.37(mf) OTS |
| 8055 | 17-18759 | Dep.(mc); $1.60(fs), $0.80(mf) OTS |
| 8089 | 17-19626 | Dep.(mc); $3.60(fs), $1.31(mf) OTS |
| 8195 | 17-19033 | Dep.(mc); $5.60(fs), $1.79(mf) OTS |
| 8239 | 17-18220 | Dep.(mc); $1.10(fs), $0.80(mf) OTS |
| 8279 | 17-18268 | Dep.(mc); $2.60(fs), $0.86(mf) OTS |
| **NADC-AW–** | **(Non-AEC)** | |
| 6226 | 17-18290 | $2.60(OTS) |
| **NAS-NRC–** | **(Non-AEC)** | |
| Pub-992 | 17-18221 | $10.00(NAS) |
| **NAS-NS–** | **(Misc.)** | |
| 3107 | 17-18660 | Dep.; $2.50(OTS) |
| **NASA-TN–** | **(Misc.)** | |
| D-1662* | 17-18859 | $0.50(OTS) |
| **NAVWEPS–** | **(Non-AEC)** | |
| 7949 | 17-17626 | See NOTS-TP-2986 |
| **NIRL-R–** | **(British)** | |
| 21 | 17-18540 | Dep.(mc) |
| 22 | 17-19219 | Dep.(mc); $0.63(BIS); 4s. 6d. (HMSO) |
| **NMI–** | **(Misc.)** | |
| 2114 | 17-18760 | Dep.(mc); $2.60(fs), $0.89(mf) OTS |
| **NOTS-TP–** | **(Non-AEC)** | |
| 2986 | 17-17626 | $1.60(OTS) |
| **NP–** | **(AEC File No. for Non-AEC Reports)** | |
| 12343 | 17-18899 | $1.60(OTS) |
| 12587 | 17-18599 | Dep. |
| 12648 | 17-18699 | |
| 12649 | 17-19455 | Dep.(mc) |
| 12650 | 17-19042 | |
| 12651 | 17-19456 | |
| 12652 | 17-18761 | |
| 12655 | 17-19417 | |
| 12666 | 17-18269 | Dep.(mc) |
| 12667 | 17-18900 | |
| 12668 | 17-18762 | Dep.(mc) |
| 12669 | 17-18763 | Dep.(mc) |
| 12670 | 17-18160 | |
| **NP-tr–** | **(AEC File No. for Non-AEC Translations)** | |
| 959 | 17-19428 | Dep.(mc); $1.60(fs), $0.80(mf) JCL or OTS |
| 961 | 17-18013 | Dep.(mc) |
| 970 | 17-18703 | Dep.(mc); $1.10(fs), $0.80(mf) JCL |
| **NSEC–** | | |
| 89 | 17-18328 | Dep.(mc); $3.60(fs), $1.16(mf) OTS |
| 104 | 17-19636 | See TID-18325 |
| **NYO–** | | |
| 2304 | 17-17627 | Dep.(mc); $6.60(fs), $2.30(mf) OTS |
| 9047 | 17-18764 | Dep.(mc); $2.60(fs), $0.86(mf) OTS |
| 9677 | 17-18291 | Dep.(mc); $7.60(fs), $2.33(mf) OTS |
| 9783 | 17-18901 | Dep.(mc); $10.50(fs), $4.16(mf) OTS |
| 9873 | 17-17947 | Dep.(mc); $2.60(fs), $1.07(mf) OTS |
| 9874 | 17-17948 | Dep.(mc); $2.60(fs), $1.07(mf) OTS |
| 10145 | 17-18106 | Dep.(mc); $1.60(fs), $0.80(mf) OTS |
| 10186 | 17-18460 | Dep.(mc); $3.60(fs), $1.19(mf) OTS |
| 10254 | 17-19115 | Phys. Letters 4: 14-16(1963) |
| 10308 | 17-18107 | See RRL-87 |
| 10354 | 17-18765 | Dep.(mc); $3.60(fs), $1.31(mf) OTS |
| 10495 | 17-18329 | Dep.(mc); $5.60(fs), $1.94(mf) OTS |
| **ORA–** | **(Misc.)** | |
| 03712-3-T | 17-18551 | See TID-18427 |
| 03712-5-P | 17-18549 | See TID-18408 |
| **ORNL–** | | |
| 1407 | 17-19627 | Dep.(mc); $9.60(fs), $3.65(mf) OTS |
| 3203 | 17-18178 | Dep.; $0.50(OTS) |
| 3208 | 17-19628 | Dep.; $2.75(OTS) |
| 3261(Suppl.) | 17-19629 | Dep.; $1.00(OTS) |
| 3266 | 17-17628 | Dep.; $2.00(OTS) |
| 3288 | 17-19677 | Dep.; $2.00(OTS) |
| 3386 | 17-19630 | Dep.; $2.50(OTS) |
| 3403 | 17-18860 | Dep.; $0.75(OTS) |
| 3407 | 17-18600 | Dep.; $6.60(fs), $2.12(mf) OTS |
| 3412 | 17-19418 | Dep.; $0.75(OTS) |
| 3416 | 17-19631 | Dep.; $2.50(OTS) |
| **ORNL-TM–** | | |
| 92 | 17-18164 | Ind. Eng. Chem. Process Design Develop. 2: 117-21(1963) |
| 358 | 17-18179 | Dep.(mc); $2.60(fs), $0.98(mf) OTS |
| 430(Suppl.) | 17-18661 | Dep.(mc); $1.10(fs), $0.80(mf) OTS |
| 449 | 17-17949 | Dep.(mc); $8.60(fs), $2.99(mf) OTS |
| 499 | 17-19034 | Dep.(mc); $1.60(fs), $0.80(mf) OTS |
| 507 | 17-18330 | Dep.; $2.60(fs), $0.98(mf) OTS |
| 531 | 17-18331 | Dep.(mc); $1.10(fs), $0.80(mf) OTS |
| 536 | 17-19632 | Dep.(mc); $1.60(fs), $0.80(mf) OTS |
| **ORO–** | | |
| 587(Vol.I) | 17-18332 | Dep.; $2.75(OTS) |
| 600 | 17-18461 | Dep.; $1.25(OTS) |
| **OTS–** | **(Misc.)** | |
| 63-21232* | 17-19667 | See JPRS-17876 |
| 63-21437* | 17-17769 | For translation see JPRS-18395 |
| 63-21460* | 17-18292 | See JPRS-18455 |
| 63-21470* | 17-17783 | See JPRS-18479 |
| 63-21476* | 17-17707 | See JPRS-18492 |
| 63-21483* | 17-19427 | See JPRS-18505 |
| 63-21502(Excerpt)* | 17-17738 | For translation see JPRS-18548(Excerpt) |
| 63-21550* | 17-17977 | See JPRS-18632 |
| **PATENTS** | **(Czechoslovakian)** | |
| 99,982 | 17-18729 | |
| 100,428 | 17-19664 | |
| **PATENTS** | **(German)** | |
| 1,143,188 | 17-18690 | |
| 1,143,276 | 17-18648 | |
| 1,143,279 | 17-18247 | |
| 1,143,624 | 17-18730 | |
| **PATENTS** | **(U. S.)** | |
| 3,076,078 | 17-18248 | |
| 3,080,308 | 17-19665 | |
| **NSS–** | | |

| Report No. | Abstract No. | Availability |
|---|---|---|
| 3,081,247 | 17-19605 | |
| 3,083,076 | 17-18168 | |
| 3,083,094 | 17-18691 | |
| 3,083,151 | 17-18249 | |
| 3,083,152 | 17-18156 | |
| 3,083,159 | 17-18250 | |
| 3,084,040 | 17-18692 | |
| 3,084,041 | 17-17965 | |
| 3,084,114 | 17-18887 | |
| 3,084,115 | 17-18506 | |
| 3,084,249 | 17-18649 | |
| 3,084,250 | 17-18584 | |
| 3,084,251 | 17-19606 | |
| 3,084,252 | 17-19607 | |
| 3,084,254 | 17-19608 | |
| 3,084,255 | 17-18650 | |
| 3,084,256 | 17-18585 | |
| 3,084,257 | 17-18251 | |
| 3,084,259 | 17-18507 | |
| 3,084,260 | 17-18252 | |
| 3,084,273 | 17-19505 | |
| 3,084,287 | 17-18586 | |
| 3,085,173 | 17-19506 | |
| 3,085,189 | 17-19507 | |
| 3,086,864 | 17-17704 | |
| 3,086,926 | 17-18214 | |
| 3,086,930 | 17-18693 | |
| 3,086,935 | 17-18253 | |
| 3,087,045 | 17-18254 | |
| 3,087,056 | 17-18255 | |
| 3,087,781 | 17-18694 | |
| 3,087,876 | 17-18695 | |
| 3,087,877 | 17-18731 | |
| 3,087,879 | 17-18732 | |
| 3,087,881 | 17-19666 | |
| **PATENTS** | **(U.S.S.R.)** | |
| 146,165 | 17-18256 | |
| **PB–** | **(Non-AEC)** | |
| 161062 | 17-19633 | $3.50(OTS) |
| **PG-Report–** | **(British)** | |
| 250 | 17-17967 | Dep. |
| 339 | 17-17968 | Dep. |
| 347 | 17-17969 | Dep. |
| 357 | 17-17970 | Dep. |
| 379 | 17-18161 | Dep. |
| 415 | 17-17971 | Dep. |
| 424 | 17-17706 | Dep. |
| 434 | 17-17972 | Dep. |
| **PNE–** | | |
| 114F | 17-19220 | Dep.; $0.50(OTS) |
| **PUC–** | | |
| 1961-47 | 17-19346 | Phys. Rev. 130: 1036-63(1963) |
| 1962-84 | 17-19347 | Phys. Rev. 130: 1064-8(1963) |
| 1963-95 | 17-19221 | Dep.(mc); $14.50(fs), $6.80(mf) OTS |
| **R–** | **(Misc.)** | |
| 410-PR* | 17-18902 | |
| **RADC-TDR–** | **(Misc.)** | |
| 62-264* | 17-18903 | |
| **REIC-Access–** | **(Non-AEC)** | |
| 60(Rev.)&61 (Pt.I) | 17-18861 | |
| 60(Rev.)&61 (Pt.II) | 17-18862 | |

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|---|---|---|
| **RFP–** | | |
| 104 | 17-19035 | Dep.(mc); $2.60(fs), $0.83(mf) OTS |
| **RHD–** | **(Non-AEC)** | |
| Vol.III, No.9 | 17-18456 | Radiological Health Data Monthly Report, Volume III, No. 9. $0.50(GPO) |
| Vol.III, No.10 | 17-18455 | Radiological Health Data Monthly Report, Volume III, No. 10. $0.50(GPO) |
| Vol.IV, No.2 | 17-18454 | Radiological Health Data Monthly Report, Volume IV, No. 2. $0.50(GPO) |
| **RISÖ–** | **(Danish)** | |
| 55 | 17-19201 | Dep.(mc) |
| **RLE-TR–** | **(Non-AEC)** | |
| 407 | 17-19457 | |
| 408 | 17-19458 | |
| **RM–** | **(Misc.)** | |
| 2888-PR* | 17-18662 | |
| **RRL–** | **(Misc.)** | |
| 87 | 17-18107 | Dep.(mc); $3.60(fs), $1.19(mf) OTS |
| **RT-EL–** | **(Italian)** | |
| (62)18 | 17-18541 | Dep.(mc) |
| **RT-FI–** | **(Italian)** | |
| (62)56 | 17-18601 | Dep.(mc) |
| (62)62 | 17-19459 | Dep.(mc) |
| **RT-FIMA–** | **(Italian)** | |
| (62)1 | 17-18270 | Dep.(mc) |
| **S–** | **(Misc.)** | |
| 453* | 17-18734 | See AD-282047 |
| **SAN–** | | |
| 1003 | 17-18271 | Dep.(mc); $3.60(fs), $1.37(mf) OTS |
| 1009 | 17-18272 | Dep.(mc); $5.60(fs), $1.94(mf) OTS |
| 1022 | 17-18333 | Dep.; $2.00(OTS) |
| **SB–** | **(Non-AEC)** | |
| 402(Rev.) | 17-18728 | $0.10(OTS) |
| 62-58 | 17-18673 | |
| **SC–** | **(Misc.)** | |
| 4776(RR) | 17-19460 | Dep.; $0.75(OTS) |
| **SCDC–** | | |
| 2759 | 17-18244 | See TID-16724 |
| 2836 | 17-18767 | See TID-16688 |
| 2845 | 17-18768 | See TID-16706 |
| 2846 | 17-18906 | See TID-16739 |
| 2882 | 17-18240 | See TID-16891 |
| **SCL-T–** | | |
| 467 | 17-18014 | Dep.(mc); $1.60(fs), $0.80(mf) JCL or OTS |
| 472 | 17-18015 | Dep.(mc); $1.10(fs), $0.80(mf) JCL |
| **SCTM–** | | |
| 21-63(24) | 17-18542 | Dep.(mc); $1.10(fs), $0.80(mf) OTS |
| **SIT-P–** | **(Misc.)** | |
| 82 | 17-19461 | See TID-18228 |
| **SLAC–** | | |
| 11 | 17-19419 | Dep.; $1.50(OTS) |
| 12 | 17-19420 | Dep.; $0.50(OTS) |
| 14 | 17-19421 | Dep.; $0.75(OTS) |

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|---|---|---|
| **SRO–** | | |
| 81 | 17-19634 | Dep.(mc); $1.10(fs), $0.80(mf) OTS |
| **STI-DOC–** | **(International Atomic Energy Agency)** | |
| 10/12 | 17-18989 | (IAEA, Vienna). Technical Reports Series No. 12 |
| 10/14 | 17-18849 | The Uranium–Carbon and Plutonium–Carbon Systems. A Thermochemical Assessment. $1.00(IAEA) |
| **STI-PUB–** | **(International Atomic Energy Agency)** | |
| 61 | 17-19518 | Theoretical Physics. Lectures Presented at the Seminar held at the Palazzino Miramare, Trieste, from 16 July to 25 August, 1962. $12.00(IAEA) |
| **STL–** | | |
| 6112 | 17-19585 | Dep.; $2.50(OTS) |
| **TCAP-P–** | | |
| 64 | 17-18352 | See TID-7651(p.331-93) |
| **TID–** | | |
| 7624 | 17-18717 | Dep.; $3.50(OTS) |
| 7644 | 17-19703 | Dep.; $3.00(OTS) |
| 7651 | 17-18334 | Dep.; $5.00(OTS) |
| 7652 | 17-18353 | Dep.; $7.00(OTS) |
| 12807 | 17-19265 | J. Inorg. Nucl. Chem. 24: 1527-38(1962) |
| 14035 | 17-18543 | Dep.(mc); $4.60(fs), $1.55(mf) OTS |
| 14713 | 17-18904 | Dep.(mc); $2.60(fs), $0.98(mf) OTS |
| 15222 | 17-19689 | Dep.(mc); $3.60(fs), $1.13(mf) OTS |
| 15223 | 17-19690 | Dep.(mc); $4.60(fs), $1.67(mf) OTS |
| 15264 | 17-18203 | J. Inorg. Nucl. Chem. 24: 1449-61(1962) |
| 16052 | 17-19691 | Dep.(mc); $2.60(fs), $1.01(mf) OTS |
| 16260 | 17-19043 | Dep.(mc); $1.60(fs), $0.80(mf) OTS |
| 16299 | 17-17645 | See BNL-6093 |
| 16343 | 17-18884 | Phys. Rev. 130: 554-64(1963) |
| 16572 | 17-17757 | Dep.(mc); $1.60(fs), $0.80(mf) OTS |
| 16595 | 17-18180 | Dep.(mc); $1.60(fs), $0.80(mf) OTS |
| 16599 | 17-19001 | Dep.(mc); Geochim. Cosmochim. Acta, 27: 345-60(1963) |
| 16601 | 17-18602 | Dep.(mc); $1.10(fs), $0.80(mf) OTS |
| 16602 | 17-18603 | Dep.(mc); $1.10(fs), $0.80(mf) OTS |
| 16603 | 17-19222 | Dep.(mc); $3.60(fs), $1.34(mf) OTS |
| 16612 | 17-19044 | Dep.(mc); $1.10(fs), $0.80(mf) OTS |
| 16616 | 17-18544 | Dep.(mc); Rev. Sci. Instr., 34: 399-401 (1963) |
| 16621 | 17-19223 | Dep.(mc); $4.60(fs), $1.49(mf) OTS |
| 16627 | 17-19224 | Dep.(mc); $2.60(fs), $0.83(mf) OTS |
| 16632 | 17-18545 | Dep.(mc); $1.60(fs), $0.80(mf) OTS |
| 16638 | 17-19225 | Dep.(mc); $1.10(fs), $0.80(mf) OTS |
| 16640 | 17-18546 | Dep.(mc); Rev. Sci. Instr., 34: 335-45 (1963) |
| 16645 | 17-18005 | Dep.(mc); $1.10(fs), $0.80(mf) OTS |
| 16648 | 17-19226 | Dep.(mc); $3.60(fs), $1.16(mf) OTS |
| 16650 | 17-17758 | Dep.(mc); $1.60(fs), $0.80(mf) OTS |
| 16659 | 17-19045 | Dep.(mc); $4.60(fs), $1.67(mf) OTS |
| 16660 | 17-18905 | Dep.(mc); $4.60(fs), $1.43(mf) OTS |
| 16676 | 17-18766 | Dep.(mc); $1.10(fs), $0.80(mf) OTS |
| 16688 | 17-18767 | Dep.(mc); $3.60(fs), $1.25(mf) OTS |
| 16696 | 17-18006 | Dep.(mc); $1.60(fs), $0.80(mf) OTS |
| 16702 | 17-19092 | Nuovo Cimento (10) 27: 860-7(1963) |
| 16706 | 17-18768 | Dep.(mc); $2.60(fs), $0.95(mf) OTS |
| 16724 | 17-18244 | Tool. Mfg. Engr. 50: No. 2, 69-72(1963) |
| 16739 | 17-18906 | Dep.(mc); $3.60(fs), $1.22(mf) OTS |
| 16740 | 17-17861 | Lab. Invest. 12: 193-8(1963) |
| 16744 | 17-18007 | Dep.(mc); $3.60(fs), $1.16(mf) OTS |
| 16887 | 17-18235 | Health Phys. 9: 236(1963) |
| 16891 | 17-18240 | Rev. Sci. Instr. 34: 302(1963) |
| 16921 | 17-19357 | Phys. Rev. 130: 1153-62(1963) |
| 17310 | 17-18907 | Dep.(mc); $1.60(fs), $0.80(mf) OTS |
| 17326 | 17-18958 | Phys. Rev. 130: 813-20(1963) |
| 17389 | 17-18954 | Phys. Rev. 130: 495-501(1963) |
| 17390 | 17-18978 | Rev. Sci. Instr. 34: 298-9(1963) |
| 17400 | 17-18809 | J. Chem. Phys. 38: 1256(1963) |
| 17420 | 17-19139 | Phys. Rev. 130: 1180-1(1963) |
| 17496 | 17-18036 | Inorg. Chem. 2: 430-1(1963) |
| 17561 | 17-18040 | J. Am. Chem. Soc. 85: 816-17(1963) |
| 17606 | 17-18370 | See TID-7652(p.275-90) |
| 17613 | 17-19109 | Nuovo Cimento (10), 27: 1439-49(1963) |
| 17639 | 17-19344 | Phys. Rev. 130: 731-4(1963) |
| 17799 | 17-18122 | J. Am. Chem. Soc. 85: 1014-16(1963) |
| 18028 | 17-18273 | Dep.(mc); $11.50(fs), $4.91(mf) OTS |
| 18126 | 17-18108 | Dep.; $0.50(OTS) |
| 18179 | 17-18959 | Phys. Rev. 130: 847-51(1963) |
| 18218 | 17-17759 | Dep.(mc); $1.60(fs), $0.80(mf) OTS |
| 18219 | 17-17760 | Dep.(mc); $1.60(fs), $0.80(mf) OTS |
| 18220 | 17-17761 | Dep.(mc); $1.60(fs), $0.80(mf) OTS |
| 18222 | 17-17762 | Dep.(mc); $1.60(fs), $0.80(mf) OTS |
| 18228 | 17-19461 | Dep.(mc); $5.60(fs), $1.82(mf) OTS |
| 18260 | 17-17763 | Dep.(mc); $4.60(fs), $1.43(mf) OTS |
| 18276 | 17-18008 | Dep.(mc); $1.10(fs), $0.80(mf) OTS |
| 18284 | 17-19202 | Dep.(mc); $6.60(fs), $2.03(mf) OTS |
| 18286 | 17-18718 | Dep.(mc); $3.60(fs), $1.40(mf) OTS |
| 18289 | 17-19422 | Dep.(mc); $4.60(fs), $1.55(mf) OTS |
| 18290 | 17-18181 | Dep.(mc); $1.60(fs), $0.80(mf) OTS |
| 18295 | 17-19046 | Dep.(mc); $4.60(fs), $1.65(mf) OTS |
| 18296 | 17-18274 | Dep.(mc); $2.60(fs), $1.01(mf) OTS |
| 18299 | 17-18182 | Dep.(mc); $3.60(fs), $1.37(mf) OTS |
| 18300 | 17-18604 | Dep.(mc); $1.10(fs), $0.80(mf) OTS |
| 18301 | 17-19423 | Dep.(mc); $1.60(fs), $0.80(mf) OTS |
| 18303 | 17-18908 | Dep.(mc); $1.60(fs), $0.80(mf) OTS |
| 18305 | 17-18109 | Dep.(mc); $2.60(fs), $0.86(mf) OTS |
| 18314 | 17-19635 | Dep.(mc); $8.10(fs), $2.72(mf) OTS |
| 18316 | 17-18393 | Dep.(mc); $2.60(fs), $0.83(mf) OTS |
| 18317 | 17-18394 | Dep.(mc); $2.60(fs), $0.89(mf) OTS |
| 18318 | 17-18395 | Dep.(mc); $2.60(fs), $0.89(mf) OTS |
| 18324 | 17-18719 | Dep.(mc); $1.10(fs), $0.80(mf) OTS |
| 18325 | 17-19636 | Dep.(mc); $6.60(fs), $2.30(mf) OTS |
| 18334 | 17-18769 | Dep.(mc); $1.60(fs), $0.80(mf) OTS |
| 18335 | 17-19462 | Dep.(mc); $1.10(fs), $0.80(mf) OTS |
| 18336 | 17-19463 | Dep.(mc); $1.10(fs), $0.80(mf) OTS |
| 18338 | 17-17764 | Dep.(mc); $1.10(fs), $0.80(mf) OTS |
| 18340 | 17-19227 | Dep.(mc); $2.60(fs), $0.95(mf) OTS |
| 18341 | 17-18770 | Dep.(mc); $1.60(fs), $0.80(mf) OTS |
| 18342 | 17-19424 | Dep.(mc); $1.10(fs), $0.80(mf) OTS |
| 18343 | 17-17950 | Dep.(mc); $1.60(fs), $0.80(mf) OTS |
| 18344 | 17-19510 | Dep.(mc); $1.60(fs), $0.80(mf) OTS |
| 18345 | 17-19425 | Dep.(mc); $1.10(fs), $0.80(mf) OTS |
| 18349 | 17-17951 | Dep.(mc); $1.60(fs), $0.80(mf) OTS |
| 18387 | 17-18771 | Dep.(mc); $1.60(fs), $0.80(mf) OTS |
| 18389 | 17-17737 | Dep.(mc); $3.60(fs), $1.34(mf) OTS |
| 18390 | 17-19637 | $3.60(fs), $1.13(mf) OTS |
| 18396 | 17-18547 | Dep.(mc); $1.60(fs), $0.80(mf) OTS |
| 18397 | 17-18548 | Dep.(mc); $3.60(fs), $1.31(mf) OTS |
| 18398 | 17-18009 | Dep.(mc); $1.10(fs), $0.80(mf) OTS |
| 18399 | 17-18010 | Dep.(mc); $1.10(fs), $0.80(mf) OTS |
| 18405 | 17-18605 | Dep.(mc); $3.60(fs), $1.22(mf) OTS |
| 18408 | 17-18549 | Dep.(mc); $1.60(fs), $0.80(mf) OTS |
| 18409 | 17-18550 | Dep.(mc); $1.60(fs), $0.80(mf) OTS |
| 18412 | 17-18772 | Dep.(mc); $12.00(fs), $5.06(mf) OTS |
| 18414 | 17-17765 | Dep.(mc); $1.10(fs), $0.80(mf) OTS |
| 18418 | 17-17952 | Dep.(mc); $6.60(fs), $2.06(mf) OTS |
| 18420 | 17-18700 | Dep.(mc); $14.00(fs), $6.41(mf) OTS |
| 18423 | 17-18011 | Dep.(mc); $1.60(fs), $0.80(mf) OTS |
| 18424 | 17-19228 | Dep.(mc); $1.10(fs), $0.80(mf) OTS |
| 18427 | 17-18551 | Dep.(mc); $1.10(fs), $0.80(mf) OTS |
| 18428 | 17-19203 | Dep.(mc); $1.10(fs), $0.80(mf) OTS |
| 18429 | 17-19204 | Dep.(mc); $1.60(fs), $0.80(mf) OTS |
| 18432 | 17-19205 | Dep.(mc); $12.50(fs), $5.33(mf) OTS |
| 18433 | 17-18773 | Dep.(mc); $1.60(fs), $0.80(mf) OTS |
| 18434 | 17-18774 | Dep.(mc); $2.60(fs), $0.83(mf) OTS |

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|---|---|---|
| 18436 | 17-18909 | Dep.(mc); $4.60(fs), $1.64(mf) OTS |
| 18438 | 17-18863 | Dep.(mc); $5.60(fs), $1.94(mf) OTS |
| 18439 | 17-19464 | Dep.(mc); $3.60(fs), $1.37(mf) OTS |
| 18440 | 17-18012 | Dep.(mc); $1.10(fs), $0.80(mf) OTS |
| 18444 | 17-19229 | Dep.(mc); $1.10(fs), $0.80(mf) OTS |
| 18446 | 17-18663 | Dep.(mc); $2.60(fs), $0.89(mf) OTS |
| 18448 | 17-17953 | Dep.(mc); $1.60(fs), $0.80(mf) OTS |
| 18450 | 17-17954 | Dep.(mc); $2.60(fs), $0.83(mf) OTS |
| **TRG-Inf. Ser.–** | **(British)** | |
| 6 | 17-18779 | Dep.; $1.60(fs), $0.80(mf) JCL |
| 107 | 17-18780 | Dep. |
| 278 | 17-17955 | Dep. |
| 279 | 17-18277 | Dep. |
| 280 | 17-18278 | Dep. |
| **TRG-Report–** | **(Non-AEC)** | |
| 466 | 17-17973 | Dep.; $0.35(BIS); 2s. 6d. (HMSO) |
| 468 | 17-18552 | Dep.; $0.42(BIS); 3s. (HMSO) |
| 486 | 17-18553 | Dep.; $0.42(BIS); 3s. (HMSO) |
| 487 | 17-18554 | Dep.; $0.63(BIS); 4s. 6d. (HMSO) |
| **TRW-ER–** | | |
| 4833 | 17-18264 | See NAA-SR-6309 |
| **UAC–** | | |
| 5812 | 17-18904 | See TID-14713 |
| 6476 | 17-18545 | See TID-16632 |
| 6480 | 17-18602 | See TID-16601 |
| 6498 | 17-18180 | See TID-16595 |
| 6501 | 17-17757 | See TID-16572 |
| 6504 | 17-18739 | See ANL-FGF-347 |
| 6512 | 17-19226 | See TID-16648 |
| 6514 | 17-19224 | See TID-16627 |
| 6536 | 17-18603 | See TID-16602 |
| 6547 | 17-18546 | See TID-16640 |
| 6548 | 17-18005 | See TID-16645 |
| 6570 | 17-19223 | See TID-16621 |
| 6571 | 17-18544 | See TID-16616 |
| 6574 | 17-19225 | See TID-16638 |
| 6579 | 17-19044 | See TID-16612 |
| 6582 | 17-17758 | See TID-16650 |
| 6583 | 17-19001 | See TID-16599 |
| 6889 | 17-18809 | See TID-17400 |
| 6966 | 17-19109 | See TID-17613 |
| 7000 | 17-18370 | See TID-7652(p.275-90) |
| 7156 | 17-19046 | See TID-18295 |
| 7184 | 17-18604 | See TID-18300 |
| 7203 | 17-18771 | See TID-18387 |
| 7229 | 17-18109 | See TID-18305 |
| **UCRL–** | | |
| 5705 | 17-18674 | Dep.(mc); $3.60(fs), $1.19(mf) OTS |
| 5705(Suppl.1) | 17-18675 | Dep.(mc); $5.60(fs), $1.85(mf) OTS |
| 5705(Suppl.2) | 17-18676 | Dep.; $4.50(OTS) |
| 6816-T | 17-18775 | Dep.(mc); $1.10(fs), $0.80(mf) OTS |
| 6967 | 17-18110 | Dep.(mc); $1.10(fs), $0.80(mf) OTS |
| 6984 | 17-18776 | Dep.(mc); $3.60(fs), $1.25(mf) OTS |
| 6990-T | 17-19047 | Dep.(mc); $8.60(fs), $2.93(mf) OTS |
| 7067 | 17-18606 | Dep.(mc); $2.60(fs), $0.95(mf) OTS |
| 7078 | 17-18561 | 3p. of Electronics 36(1963) |
| 7147 | 17-18638 | Rev. Sci. Instr. 34: 306-7(1963) |
| 7204 | 17-17974 | Dep.; $0.50(OTS) |
| 7221 | 17-18910 | Dep.(mc); $1.60(fs), $0.80(mf) OTS |
| 7223 | 17-18607 | Dep.; $0.50(OTS) |
| 7271 | 17-18911 | Dep.(mc); $1.60(fs), $0.80(mf) OTS |
| 10009(Rev.) | 17-18555 | Dep.(mc); $3.60(fs), $1.16(mf) OTS |
| 10196 | 17-18556 | Dep.(mc); $1.10(fs), $0.80(mf) OTS |
| 10215 | 17-18396 | Dep.(mc); $2.60(fs), $0.89(mf) OTS |
| 10311 | 17-18677 | Dep.(mc); $5.60(fs), $1.79(mf) OTS |
| 10324 | 17-17975 | Dep.(mc); $1.60(fs), $0.80(mf) OTS |
| 10346 | 17-19104 | Nuovo Cimento (10), 27: 1352-8(1963) |
| 10351 | 17-18807 | J. Appl. Phys. 34: 406-15(1963) |
| 10391 | 17-19126 | Phys. Rev. 130: 762-5(1963) |
| 10472 | 17-19351 | Phys. Rev. 130: 1100-8(1963) |
| 10533 | 17-19137 | Phys. Rev. 130: 1171-7(1963) |
| 10536 | 17-18960 | Phys. Rev. 130: 864-8(1963) |
| 10539 | 17-19128 | Phys. Rev. 130: 769-75(1963) |
| 10567 | 17-18063 | Phys. Rev. 130: 611-12(1963) |
| 10593 | 17-19146 | Phys. Rev. 130: 1264-7(1963) |
| 10607 | 17-19465 | Dep.; $2.25(OTS) |
| 10634 | 17-17652 | Dep.; $2.50(OTS) |
| 10661 | 17-18041 | J. Am. Chem. Soc. 85: 817(1963) |
| 13042(Rev.) | 17-18222 | $3.60(fs), $1.34(mf) OTS |
| 13080 | 17-18745 | See HE-150-204 |
| **UCRL-Trans–** | | |
| 898(L) | 17-18184 | Dep.(mc); $1.60(fs), $0.80(mf) JCL or OTS |
| 899(L) | 17-18559 | Dep.(mc); $2.60(fs), $0.86(mf) JCL |
| 903(L) | 17-18016 | Dep.(mc); $4.60(fs), $1.46(mf) JCL |
| 913(L) | 17-18781 | Dep.(mc); $1.60(fs), $0.80(mf) JCL |
| 916(L) | 17-17978 | Dep.(mc); $1.60(fs), $0.80(mf) JCL |
| 917(L) | 17-19048 | Dep.(mc); $1.10(fs), $0.80(mf) JCL |
| 928(L) | 17-18916 | Dep.(mc); $1.60(fs), $0.80(mf) JCL |
| 938(L) | 17-18017 | Dep.(mc); $2.60(fs), $0.95(mf) JCL |
| **UNC–** | **(Misc.)** | |
| 5046 | 17-18864 | Dep.(mc); $7.60(fs), $2.42(mf) OTS |
| 5051 | 17-19586 | Dep.(mc); $4.60(fs), $1.64(mf) OTS |
| **UR–** | | |
| 623 | 17-17766 | Dep.; $9.60(fs), $3.71(mf) OTS |
| **USNRDL-TR–** | **(Non-AEC)** | |
| 603 | 17-17653 | |
| 616 | 17-17767 | |
| **UVA–** | | |
| 198-62S | 17-18223 | Dep.(mc); $1.60(fs), $0.80(mf) OTS |
| 245-62S | 17-18275 | Dep.(mc); $1.10(fs), $0.80(mf) OTS |
| **VDIT–** | **(Swedish)** | |
| 16(3.1) | 17-18865 | Dep.(mc) |
| **WAPD-MRP–** | | |
| 102 | 17-19638 | Dep.; $2.50(OTS) |
| **WAPD-T–** | | |
| 1377 | 17-19206 | Dep.(mc); $1.60(fs), $0.80(mf) OTS |
| 1506 | 17-19230 | Dep.(mc); Nucl. Sci. Eng., 15: 146-57 (1963) |
| 1510 | 17-18224 | Dep.(mc); $1.60(fs), $0.80(mf) OTS |
| 1516 | 17-18225 | Dep.(mc); $2.60(fs), $1.10(mf) OTS |
| 1524 | 17-19207 | Dep.(mc); $1.10(fs), $0.80(mf) OTS |
| 1547 | 17-18276 | Dep.(mc); $2.60(fs), $0.95(mf) OTS |
| **WAPD-TM–** | **(Misc.)** | |
| 300 | 17-19587 | Dep.; $5.00(OTS) |
| 350 | 17-18866 | Dep.; $0.50(OTS) |
| 363 | 17-19208 | Dep.; $0.75(OTS) |
| 364 | 17-19209 | Dep.; $1.75(OTS) |
| **WCAP–** | **(Misc.)** | |
| 2059* | 17-18664 | Dep.(mc) |
| 4185 | 17-19639 | Dep.(mc); $1.10(fs), $0.80(mf) OTS |
| **WSEG-RM–** | **(Non-AEC)** | |
| 24 | 17-18651 | |
| **Y–** | | |
| 1400 | 17-18665 | Dep.; $2.00(OTS) |
| 1414 | 17-18557 | Dep.; $0.50(OTS) |
| 1415 | 17-18558 | Dep.; $0.50(OTS) |

| Report No. ZFK-WF– | Abstract No. (German) | Availability |
|---|---|---|
| 18 | 17-18397 | Dep.(mc) |

| Report No. ZPh– | Abstract No. (Non-AEC) | Availability |
|---|---|---|
| 118 | 17-19466 | $2.60(OTS) |
| 133 | 17-19467 | $2.60(OTS) |